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# ANTENNA POSITION INDICATORS

## GROUP MANUAL

CONTRACT: NObs 4817

1 DECEMBER 1965





0967-128-2010

ANTENNA POSITION INDICATORS

GROUP MANUAL

GENERAL DYNAMICS/ELECTRONICS

SAN DIEGO, CALIFORNIA

CONTRACT: NObs 4817

Prepared by:

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1 DECEMBER 1965





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## SECTION I

### GENERAL DESCRIPTION

#### 1-1 Introduction.

This instruction manual contains maintenance instructions for antenna position indicators manufactured by Superior Manufacturing and Instrument Corp., Long Island City, New York. The indicators are in accordance with the design requirements of General Dynamics/Electronics Specification Control Drawing 3014001.

The indicators are of the synchro-balanced servo-loop type and are energized by synchro control signals derived from position control equipment in the antenna pedestal. Dial presentation and readout of the indicators are in terms of antenna bearing and elevation in degrees.

Six of the indicators covered in this manual function as antenna elevation and bearing position control devices. These indicators control the operation of positioning equipment in the antenna pedestal by the manual or electrical positioning of their pointers.

Leading particulars of each antenna position indicator covered in this manual are given in Table 1-1.

TABLE 1-1. ANTENNA POSITION INDICATORS, LEADING PARTICULARS.

<u>Antenna Bearing Indicator (Part No. 730-900-1)</u>	
Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	0 to 360 degrees
Pointer Readout	
1) . . . . .	Ship's Heading Dial Card
2) . . . . .	Antenna Bearing
3) . . . . .	Ordered Bearing
Input Signals (3-wire, 60 cps)	
1) . . . . .	Ship's Heading
2) . . . . .	Antenna Position
3) . . . . .	True Ship's Heading
4) . . . . .	Ordered Acquisition
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S
<u>Antenna Elevation Indicator (Part No. 730-900-2)</u>	
Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	-10 to 110 degrees
Pointer Readout	
1) . . . . .	Antenna Elevation
2) . . . . .	Ordered Elevation



Section I  
General Description

TABLE 1-1. ANTENNA POSITION INDICATORS, LEADING PARTICULARS. - Cont'd.

Antenna Elevation Indicator - Cont'd

Input Signals (3-wire, 60 cps)	
1) . . . . .	Antenna Position
2) . . . . .	True or Relative Data
3) . . . . .	Ordered Acquisition
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector . . . . .	MS3102A-24-28S

Manual Ordered Bearing Indicator (Part No. 730-900-3)

Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	0 to 360 degrees
Pointer Readout . . . . .	Ordered Bearing
Input Signals	
1) 24-28 vdc . . . . .	Manual Clutch Excitation
2) 24-28 vdc . . . . .	Servo Clutch Excitation
3) 3-wire 60 cps. . . . .	Synchro Excitation
4) -5 to +5 vac . . . . .	Slew Voltage
Output Signals (3-wire, 60 cps)	
1) (23TX6b Transmitter) . . . . .	Ordered Bearing
2) (23CDX6b Transmitter) . . . . .	Ordered Bearing
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector . . . . .	MS3102A-24-28S

Manual Ordered Elevation Indicator (Part No. 730-900-4)

Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	-10 to 110 degrees
Pointer Readout . . . . .	Ordered Elevation
Input Signals	
1) 24-28 vdc . . . . .	Manual Clutch Excitation
2) 24-28 vdc . . . . .	Servo Clutch Excitation
3) 3-wire, 60 cps . . . . .	Synchro Excitation
4) -5 to +5 vac . . . . .	Slew Voltage
Output Signals (3-wire, 60 cps)	
1) (23TX6b Transmitter) . . . . .	Ordered Elevation
2) (23CDX6b Transmitter) . . . . .	Ordered Elevation
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector . . . . .	MS3102A-24-28S

Bearing Limit Indicator (Part No. 730-900-5)

Length. . . . .	5-1/2 inches
Overall Width/Height . . . . .	4 inches
Dial Scale (1 degree increments) . . . . .	-170 to 530 degrees
Pointer Readout . . . . .	Antenna Bearing
Input Signal (3-wire, 60 cps) . . . . .	Antenna Position
Input Power . . . . .	115 v, 60 cps



TABLE 1-1. ANTENNA POSITION INDICATORS, LEADING PARTICULARS, - Cont'd.

Bearing Limit Indicator - Cont'd

Mounting. . . . .	Flange-mounted
(No mating connector). . . . .	Hook-up made directly to receiver

Elevation Limit Indicator (Part No. 730-900-6)

Length. . . . .	5-1/2 inches
Overall Width/Height . . . . .	4 inches
Dial Scale (5 degree increments) . . . . .	-15 to 95 degrees
Pointer Readout . . . . .	Antenna Elevation
Input Signal (3-wire, 60 cps) . . . . .	Antenna Position
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
(No mating connector). . . . .	Hook-up made directly to receiver

Acquisition Bearing Indicator (Part No. 730-900-7)

Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	0 to 360 degrees
Pointer Readout	
1) . . . . .	Ship's Heading Dial Card
2) . . . . .	Antenna Bearing
Input Signals (3-wire, 60 cps)	
1) . . . . .	Ship's Heading Dial Card
2) . . . . .	True or Relative Data
3) . . . . .	Antenna Position
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S

Acquisition Elevation Indicator (Part No. 730-900-8)

Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	-10 to 110 degrees
Pointer Readout . . . . .	Antenna Elevation
Input Signals (3-wire, 60 cps)	
1) . . . . .	True or Relative Data
2) . . . . .	Antenna Position
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S

Ship's Heading Indicator (Part No. 730-900-9)

Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	0 to 360 degrees
Pointer Readout (Unmarked) . . . . .	Ship's Heading Dial Card
Input Signal (3-wire, 60 cps) . . . . .	Ship's Heading

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TABLE 1-1. ANTENNA POSITION INDICATORS, LEADING PARTICULARS.- Cont'd.

Ship's Heading Indicator - Cont'd

Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S

Bearing Limit Indicator - Command Control (Part No. 730-900-10)

Length. . . . .	5-1/2 inches
Overall Width/Height . . . . .	4 inches
Dial Scale (5 degree increments) . . . . .	-280 to 280 degrees
Pointer Readout . . . . .	Antenna Bearing
Input Signal (3-wire, 60 cps). . . . .	Antenna Position
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
(No mating connector). . . . .	Hook-up made directly to receiver

Elevation Limit Indicator - Command Control (Part No. 730-900-11)

Length. . . . .	5-1/2 inches
Overall Width/Height . . . . .	4 inches
Dial Scale (5 degree increments) . . . . .	-13 to 113 degrees
Pointer Readout . . . . .	Antenna Elevation
Input Signal (3-wire, 60 cps). . . . .	Antenna Position
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
(No mating connector). . . . .	Hook-up made directly to receiver

Manual Ordered Bearing Indicator - TM2 - (Part No. 730-900-12)

Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	0 to 360 degrees
Pointer Readout . . . . .	Ordered Bearing
Input Signals	
1) 24-28 vdc . . . . .	Manual Clutch Excitation
2) 24-28 vdc . . . . .	Servo Clutch Excitation
3) -5 to +5 vac . . . . .	Slew Voltage
Output Signals (3-wire, 60 cps)	
1) (23TX6b Transmitter) . . . . .	Ordered Bearing
2) (23CDX6b Transmitter) . . . . .	Ordered Bearing
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S

Manual Ordered Elevation Indicator - TM2 - (Part No. 730-900-13)

Length. . . . .	11-7/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	-10 to 110 degrees
Pointer Readout . . . . .	Ordered Elevation



TABLE 1-1. ANTENNA POSITION INDICATORS, LEADING PARTICULARS,- Cont'd.

Manual Ordered Elevation Indicator - TM2 - Cont'd

Input Signals	
1) 24-28 vdc . . . . .	Manual Clutch Excitation
2) 24-28 vdc . . . . .	Servo Clutch Excitation
3) -5 to +5 vac . . . . .	Slew Voltage
Output Signals (3-wire, 60 cps)	
1) (23TX6b Transmitter) . . . . .	Ordered Elevation
2) (23CDX6b Transmitter) . . . . .	Ordered Elevation
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S

Manual Ordered Bearing Indicator - Command Control - (Part No. 730-900-14)

Length. . . . .	7-3/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	0 to 360 degrees
Pointer Readout . . . . .	Ordered Bearing
Input Signal 24-28 vdc . . . . .	Manual Clutch Excitation
Output Signals (3-wire, 60 cps)	
1) (23TX6b Transmitter) . . . . .	Ordered Bearing
2) (23CDX6b Transmitter) . . . . .	Ordered Bearing
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S

Manual Ordered Elevation Indicator - Command Control - (Part No. 730-900-15)

Length. . . . .	7-3/8 inches
Case Width/Height . . . . .	5-1/2 inches
Dial Scale (1 degree increments) . . . . .	-10 to 110 degrees
Input Signal 24-28 vdc . . . . .	Manual Clutch Excitation
Output Signals (3-wire, 60 cps)	
1) (23TX6b Transmitter) . . . . .	Ordered Elevation
2) (23CDX6b Transmitter) . . . . .	Ordered Elevation
Input Power . . . . .	115 v, 60 cps
Mounting. . . . .	Flange-mounted
Mating Connector. . . . .	MS3102A-24-28S

1-2 Scope of Manual.

This manual contains operation and maintenance instruction for the antenna position indicators listed in Table 1-1. The manual is arranged in five sections to provide the following information:

a. SECTION I - General Description - Section I contains introductory information pertaining to description and function of the antenna position indicators.

b. SECTION II - Theory of Operation - Section II provides a general discussion on the electrical and mechanical operation of the antenna position indicators.

c. SECTION III - Maintenance - Section III provides preventive and corrective maintenance instructions and schedules necessary to maintain satisfactory operation of antenna

## Section I

### General Description

position indicators and to enable operating personnel to restore malfunctioning indicators to serviceable condition.

d. SECTION IV - Parts List - Section IV provides a complete list of replaceable and/or repairable electrical and electronic components of the antenna position indicators.

e. SECTION V - Schematic Diagrams - Section V contains schematic diagrams and illustrations in support of maintenance instructions.

The information presented in this manual pertains only to operation and service to the antenna position indicators. Refer to applicable publication(s) covering operating and service of related equipment.

#### 1-3 Purpose and Function of Equipment.

The antenna position indicators receive command signals from the antenna pedestal and provide a visual indication of antenna bearing and elevation coordinates.

The "Manual Ordered" indicators are mechanically driven dials used in conjunction with control devices that generate antenna position commands or receive synchro indication of antenna elevation or bearing coordinates.

1-3.1 Antenna Bearing Indicator. The Antenna Bearing Indicator (Figure 1-1) displays three items of coordinate information:

- a. Ship's Heading
- b. Antenna Bearing
- c. Ordered Antenna Bearing

The ship's heading is indicated by a rotating disc within a 0 to 360 degree calibrated dial ring. The antenna bearing and ordered antenna bearing coordinates are indicated by pointers on the calibrated dial ring. The input data to the indicator consists of the following signals:

- a. Ship's Heading - a 3-wire, 60 cps synchro input derived from the ship's navigational system.
- b. Antenna Bearing - a 3-wire, 60 cps antenna position synchro input and a 3-wire, 60 cps true or relative data synchro input. The antenna bearing pointer displays the algebraic sum of the two synchro inputs.
- c. Ordered Antenna Bearing - a 3-wire, 60 cps ordered bearing synchro input and a 3-wire, 60 cps true or relative data synchro input. The ordered bearing antenna pointer displays the algebraic sum of the two synchro inputs.

1-3.2 Antenna Elevation Indicator. The Antenna Elevation Indicator (Figure 1-2) displays two items of coordinate information:

- a. Antenna Elevation
- b. Ordered Antenna Elevation

Both coordinates are indicated by pointers. The input data to the indicator consists of the following signals:

- a. Antenna Elevation - a 3-wire, 60 cps antenna position synchro input and a 3-wire, 60 cps true or relative data synchro input. The antenna elevation pointer displays the algebraic sum of the two synchro inputs.



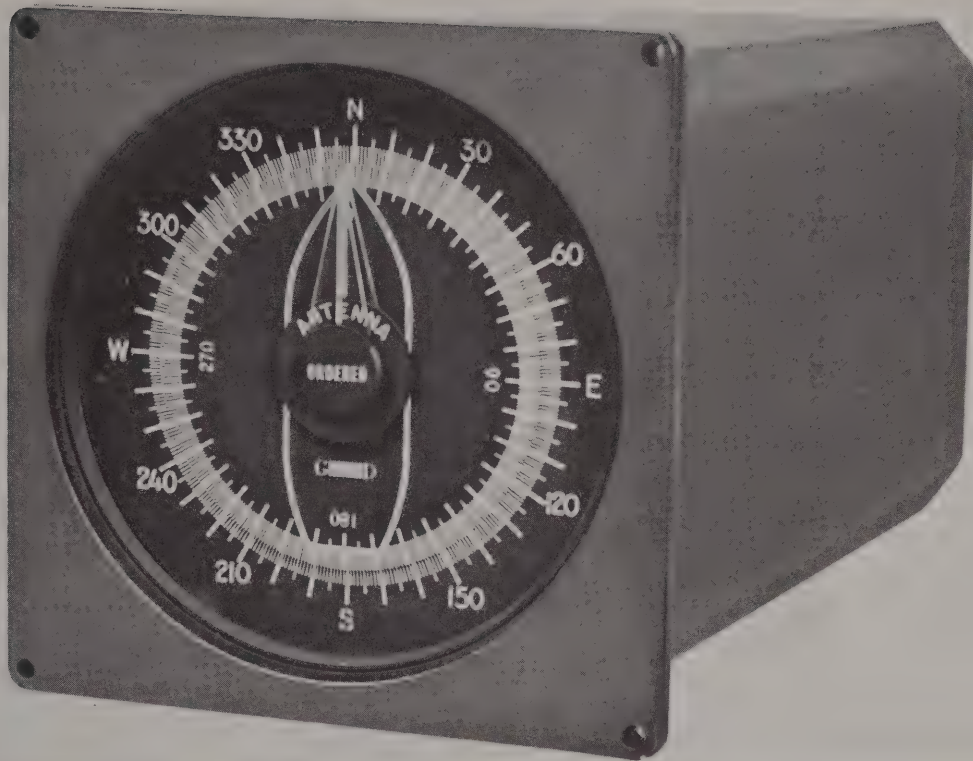


Figure 1-1. Antenna Bearing Indicator.

b. Ordered Antenna Elevation - a 3-wire, 60 cps ordered antenna elevation synchro input and a 3-wire, 60 cps true or relative data synchro input. The ordered antenna elevation pointer displays the algebraic sum of the two synchro inputs.

1-3.3 Manual Ordered Bearing Indicator. The Manual Ordered Bearing Indicator (Figure 1-3) displays the ordered bearing of the antenna. The indicator has three modes of operation for ordering the bearing of the antenna: MANUAL, AUTOMATIC, and SLEW. In the manual mode of antenna positioning, the indicator handwheel has control of positioning the indicator mechanism and pointer. In the automatic mode of antenna positioning, the indicator responds to a 3-wire, 60 cps synchro signal derived from an antenna. In the slew mode of antenna positioning, a variable ac voltage is applied to the indicator to provide an output slew rate up to 35 degrees per second. The output of the indicator consists of two 60 cps synchro signals. One is a 3-wire/60 cps TX signal and the second is a 3-wire CDX signal. The 3-wire CDX signal is applied to related equipment in the antenna pedestal for positioning control. The 3-wire TX signal is used to transmit the indicator position to another area. The second set of 3-wire of the CDX synchro receives relative or stabilized data.

1-3.4 Manual Ordered Elevation Indicator. The Manual Ordered Elevation Indicator (Figure 1-4) displays the ordered elevation of the antenna. Its modes of operation and its output signals are identical to that of the Manual Ordered Bearing Indicator.

1-3.5 Bearing Limit Indicator. The Bearing Limit Indicator (Figure 1-5) displays the antenna bearing at all times. Its control signal consists of a single 3-wire, 60 cps synchro signal derived from the antenna pedestal. Pointer readout is from -180 degrees to +540 degrees on a calibrated dial. The scale area from -160 degrees to -170 degrees is cross-hatched in white and black and the areas from -170 degrees to end-scale and +530 degrees end-scale are colored red to indicate the maximum or critical areas of antenna rotation. The antenna positioning equipment has elec-



Figure 1-2. Antenna Elevation Indicator.



Figure 1-3. Manual Ordered Bearing Indicator (Typical).



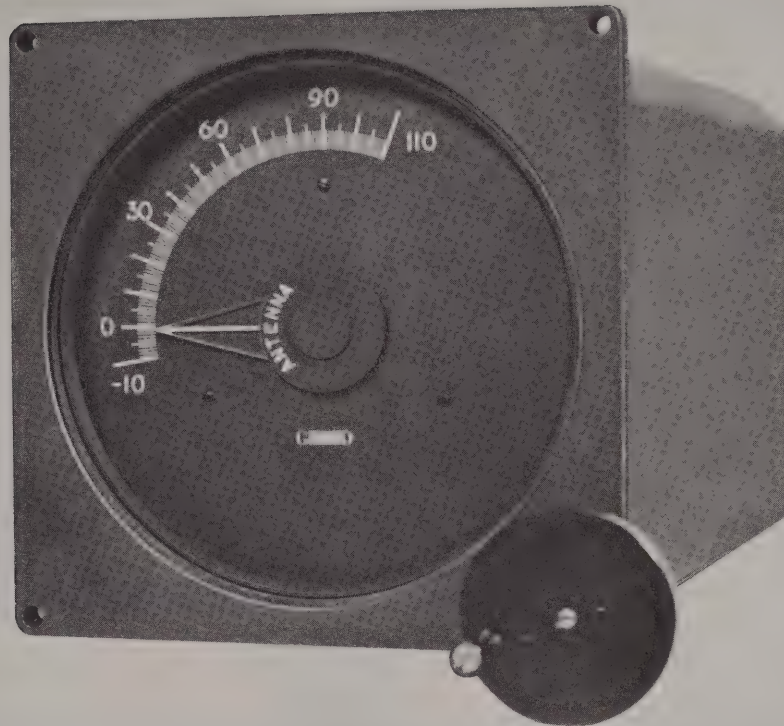


Figure 1-4. Manual Ordered Elevation Indicator (Typical).

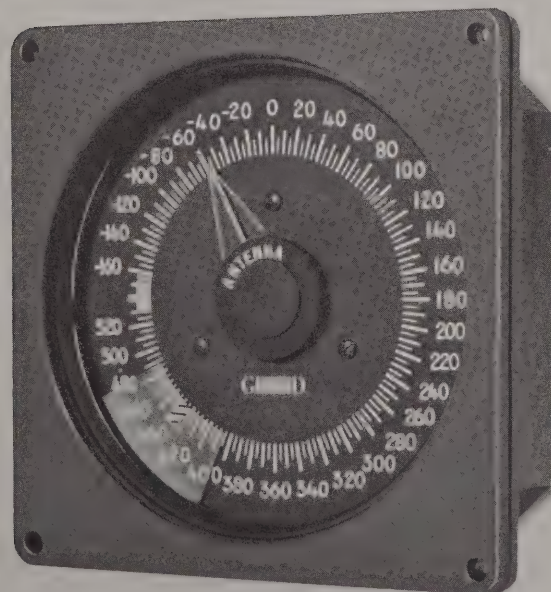


Figure 1-5. Bearing Limit Indicator.

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### General Description

trical drive limits at -170 degrees and +170 degrees. The limit at -170 degrees is fixed but the limit at +170 degrees is adjustable to +530 degrees. An adjustable transparent marker is provided on the indicator to identify the position of the higher limit set on the electrical drive.

**1-3.6 Elevation Limit Indicator.** The Elevation Limit Indicator (Figure 1-6) displays the antenna elevation at all times. Its control signal consists of a single 3-wire, 60 cps synchro signal derived from the antenna pedestal. Pointer readout is from -15 degrees to 95 degrees on a calibrated dial. The scale areas from -7 degrees to -12 degrees, and 85 degrees to 92 degrees are cross-hatched in white and black. Scale areas from -12 degrees to -15 degrees, and 92 degrees to 95 degrees are colored red. Both areas indicate maximum and critical degrees of antenna declination and elevation. The antenna positioning equipment has electrical drive limits set at -12 degrees and 92 degrees with mechanical stops set at -15 degrees and 95 degrees.

**1-3.7 Acquisition Bearing Indicator.** The Acquisition Bearing Indicator (Figure 1-7) displays the true or relative antenna bearing and the ship's true or relative heading. The indicator is identical to the Antenna Bearing Indicator except for the exclusion of the ordered bearing display.

**1-3.8 Acquisition Elevation Indicator.** The Acquisition Elevation Indicator (Figure 1-8) displays the true or relative antenna elevation position. The indicator is identical to the Antenna Elevation Indicator except that the ordered elevation display is not included.

**1-3.9 Ship's Heading Indicator.** The Ship's Heading Indicator (Figure 1-9) displays the ship's true heading. The indicator is identical to the Antenna Bearing Indicator except for the antenna bearing and the ordered bearing displays.

**1-3.10 Bearing Limit Indicator - Command Control.** The Bearing Limit Indicator - Command Control (Figure 1-10) is functionally identical to the Bearing Limit Indicator except that the dial



Figure 1-6. Elevation Limit Indicator.





Figure 1-7. Acquisition Bearing Indicator.

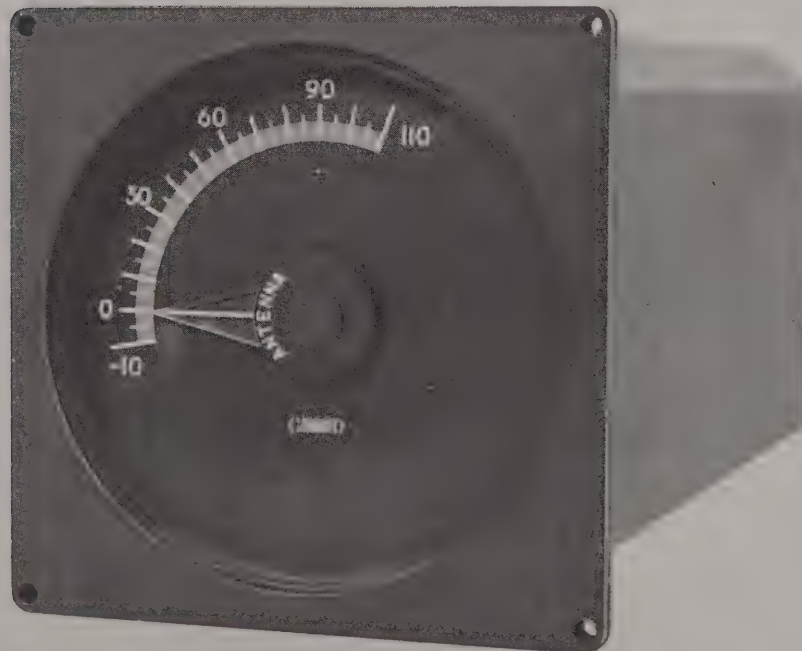


Figure 1-8. Acquisition Elevation Indicator.

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General Description



Figure 1-9. Ship's Heading Indicator.



Figure 1-10. Bearing Limit Indicator - Command Control.



scale is calibrated from -280 degrees to 280 degrees. Warning areas of antenna positioning are indicated by white and black cross-hatching from -260 degrees to -270 degrees, and 260 degrees to 270 degrees, and critical positions from -270 degrees to -280 degrees, and 270 degrees to 280 degrees. This indicator does not include the adjustable limit indicating marker.

1-3.11 Elevation Limit Indicator - Command Control. The Elevation Limit Indicator - Command Control (Figure 1-11) is functionally identical to the Elevation Limit Indicator except that the dial scale is extended to -13 degrees and +113 degrees. Warning areas of antenna positioning are indicated by white and black cross-hatching from 105 degrees to 110 degrees and -5 degrees to -10 degrees and critical positioning from 110 degrees to 113 degrees, and -10 degrees to -13 degrees.

1-3.12 Manual Ordered Bearing Indicator - TM2. The Manual Ordered Bearing Indicator - TM2 (Figure 1-3) is identical to the Manual Ordered Bearing Indicator except that it cannot be operated from a remote synchro control position.

1-3.13 Manual Ordered Elevation Indicator - TM2. The Manual Ordered Elevation Indicator - TM2 (Figure 1-4) is identical to the Manual Ordered Elevation Indicator except that it cannot be operated from a remote synchro control position.

1-3.14 Manual Ordered Bearing Indicator - Command Control. The Manual Ordered Bearing Indicator - Command Control (Figure 1-3) is identical to the Manual Ordered Bearing Indicator except that it cannot be operated from a remote synchro control position and it cannot be slewed for coarse antenna positioning.

1-3.15 Manual Ordered Elevation Indicator - Command Control. The Manual Ordered Elevation Indicator - Command Control (Figure 1-4) is identical to the Manual Ordered Elevation Indicator except that it cannot be operated from a remote synchro control position and it cannot be slewed for coarse antenna positioning.

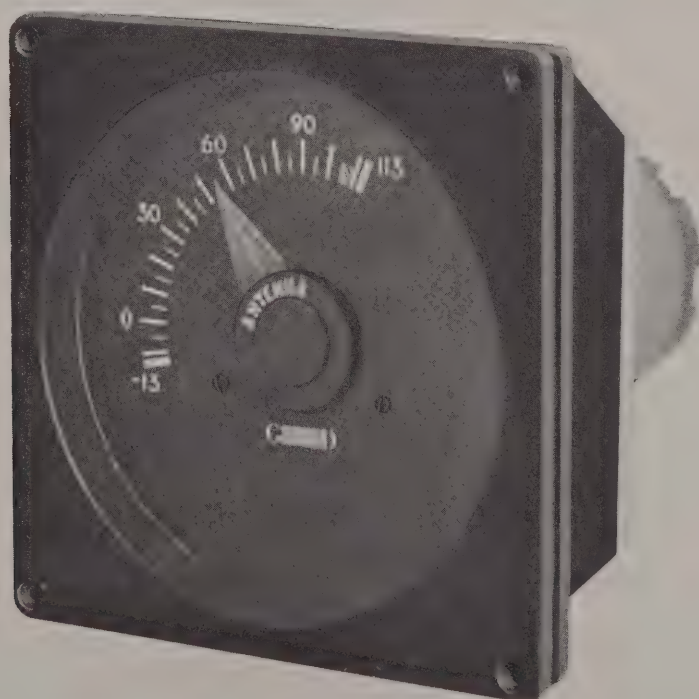


Figure 1-11. Elevation Limit Indicator - Command Control.





## SECTION II

### THEORY OF OPERATION

#### 2-1 General.

The antenna position indicators may be classified into three basic types with respect to their general principles of operation. The basic types and the indicators associated with each type are listed in Tables 2-1 through 2-3.

TABLE 2-1. PRIMARY TYPE INDICATORS.

Indicator	Part No.	GD/E Spec.
Antenna Bearing Indicator . . . . .	730-900-1	3014001-1
Antenna Elevation Indicator . . . . .	730-900-2	3014001-2
Acquisition Bearing Indicator . . . . .	730-900-7	3014001-7
Acquisition Elevation Indicator. . . . .	730-900-8	3014001-8
Ship's Heading Indicator . . . . .	730-900-9	3014001-9

TABLE 2-2. FOLLOWER TYPE INDICATORS.

Indicator	Part No.	GD/E Spec.
Bearing Limit Indicator . . . . .	730-900-5	3014001-5
Elevation Limit Indicator . . . . .	730-900-6	3014001-6
Bearing Limit Indicator - Command Control . . . . .	730-900-10	3014001-10
Elevation Limit Indicator - Command Control. . . . .	730-900-11	3014001-11

TABLE 2-3. CONTROL TYPE INDICATORS.

Indicator	Part No.	GD/E Spec.
Manual Ordered Bearing Indicator . . . . .	730-900-3	3014001-3
Manual Ordered Elevation Indicator . . . . .	730-900-4	3014001-4

TABLE 2-3. CONTROL TYPE INDICATORS. Cont'd.

Indicator	Part No.	GD/E Spec.
Manual Ordered Bearing Indicator - TM2. . . . .	730-900-12	3014001-12
Manual Ordered Elevation Indicator - TM2 . . . . .	730-900-13	3014001-13
Manual Ordered Bearing Indicator - Command Control. . .	730-900-14	3014001-14
Manual Ordered Elevation Indicator - Command Control . .	730-900-15	3014001-15

## 2-2 Primary-Type Indicator Operation.

The primary-type indicator provides a visual display of coordinate information received from two or more of the following signal sources:

- 1) The antenna pedestal
- 2) The ship's navigational system
- 3) An external pointing source

Each signal source generates a control signal which consists of a 3-wire 60-cycle synchro signal. The control signals are low power voltages which define an angle and are applied to the indicator for visual presentation. The path and processing of each signal in each of the primary-type indicators are shown in Figures 2-1 through 2-5.

The control signals are applied to the stator windings of a synchro control transformer where an "error" voltage is developed across the rotor. The error voltage is proportional to the sine of the difference between the monitored angle at the stator and the angular position of the rotor shaft with respect to the stator. The error voltage is applied to a transistorized servo amplifier which modifies the voltage sufficiently to drive a servomotor. The servomotor is mechanically coupled to the synchro control transformer rotor through a reduction gear train and repositions the rotor until the error voltage is reduced to zero or a suitable null. The indicator pointer, identified with the signal source, is installed on the rotor shaft interpreting the rotor shaft angle in terms of bearing, elevation, or ship's heading coordinates.

## 2-3 Follower-Type Indicator Operation.

The follower-type indicator is a simple synchro torque receiver indicator having its pointer coupled directly to the synchro torque receiver shaft. A block diagram of a typical follower-type indicator is given in Figure 2-6.

The indicator receives one control signal generated in the antenna pedestal. The signal is a 3-wire 60-cycle voltage sufficient to energize and drive a torque receiver. The torque receiver will reposition itself to correspond in angular degrees to the position of the synchro control transmitter rotor located in the antenna pedestal positioning mechanism.

## 2-4 Control-Type Indicator Operation.

The control-type indicator provides CDX synchro control signals to the antenna pedestal for antenna positioning, and TX synchro control signals to a computer which uses this data to compute ship's stabilization synchro data for use throughout the ship. Typical block diagrams of control-type indicators are given in Figures 2-7 through 2-9.



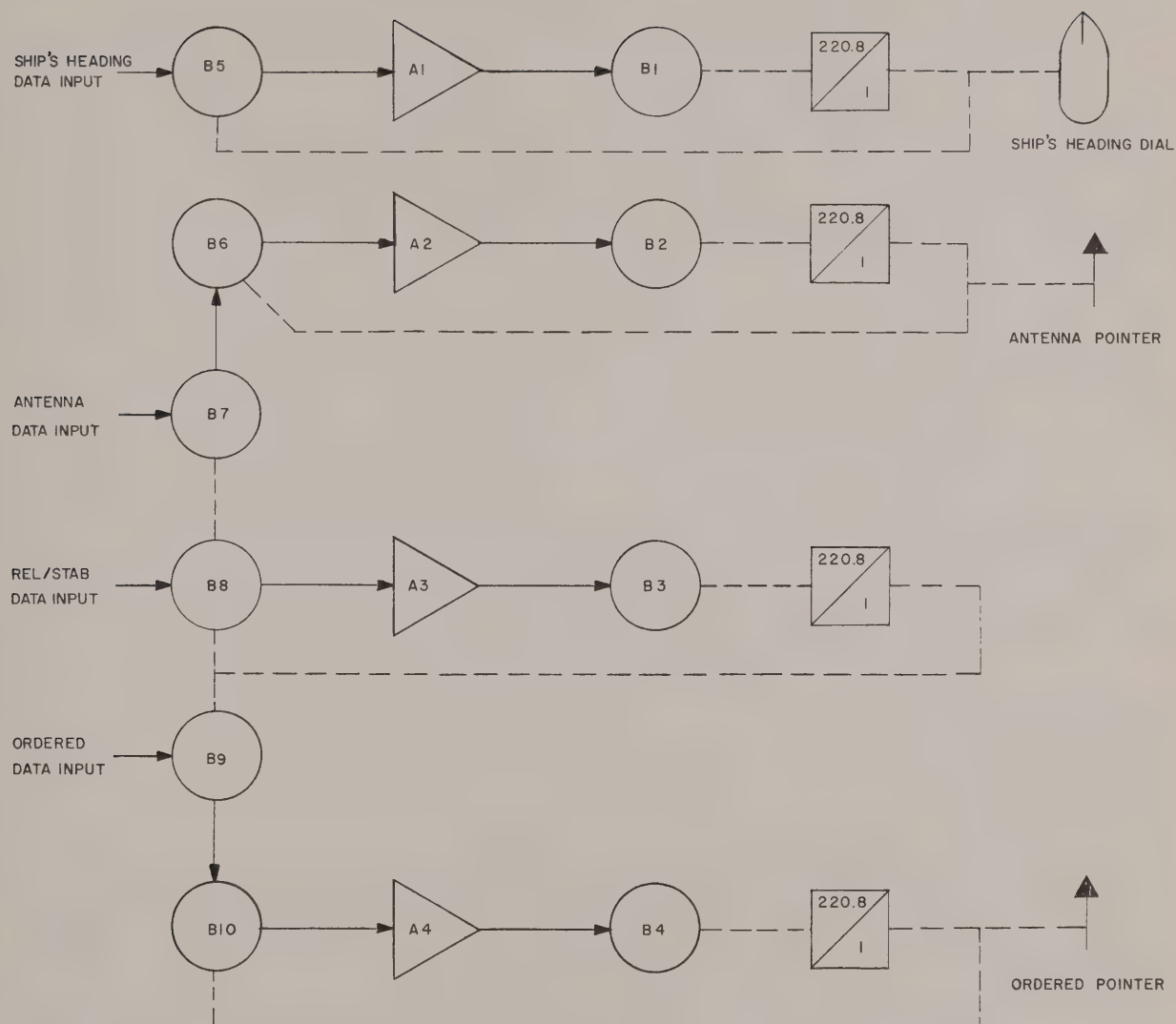


Figure 2-1. Antenna Bearing Indicator, Block Diagram.

The control-type indicator is operated manually or remotely from a remote control position. In the manual mode of operation the indicator handwheel is mechanically coupled to the pointer, a synchro torque transmitter and a synchro control differential transmitter through an electrically actuated clutch. The clutch is energized when the indicator is set or switched for manual operation. In the remote mode of operation a synchro-controlled servo loop is mechanically coupled to the two transmitters through a second electrically actuated clutch. The synchro-controlled servo loop circuit function and operation is identical to that of the primary-type indicator. The signal source for this circuit is the antenna synchro transmitter. It should be noted that the Manual Ordered Bearing and Manual Ordered Elevation indicators of the TM2 and Command Control configuration do not have provisions for remote synchro positioning control

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Theory of Operation

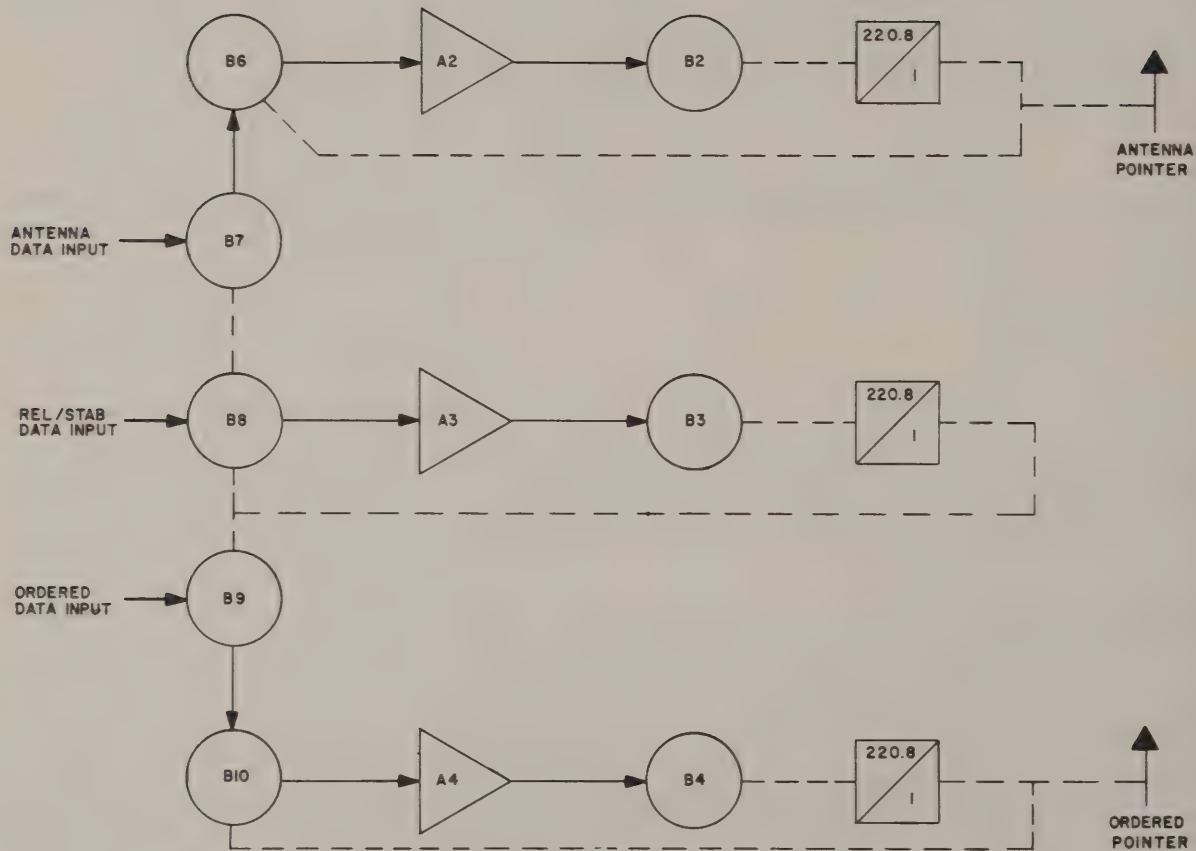


Figure 2-2. Antenna Elevation Indicator, Block Diagram.

Provision for slewing and positioning the indicator is made by the application of a voltage from an external potentiometer to the servo loop amplifier in the indicator. The slew or position voltage appears as an error voltage causing the indicator pointer and mechanism to rotate until the voltage is removed. The slew rate, or the rate of speed at which the pointer will rotate, is determined by the amount of applied slew voltage. The maximum slew rate at which the indicator pointer will rotate is 35 degrees per second. It should be noted that the Manual Ordered Bearing and Manual Ordered Elevation indicators of the Command Control configuration do not have the slew capability described above.



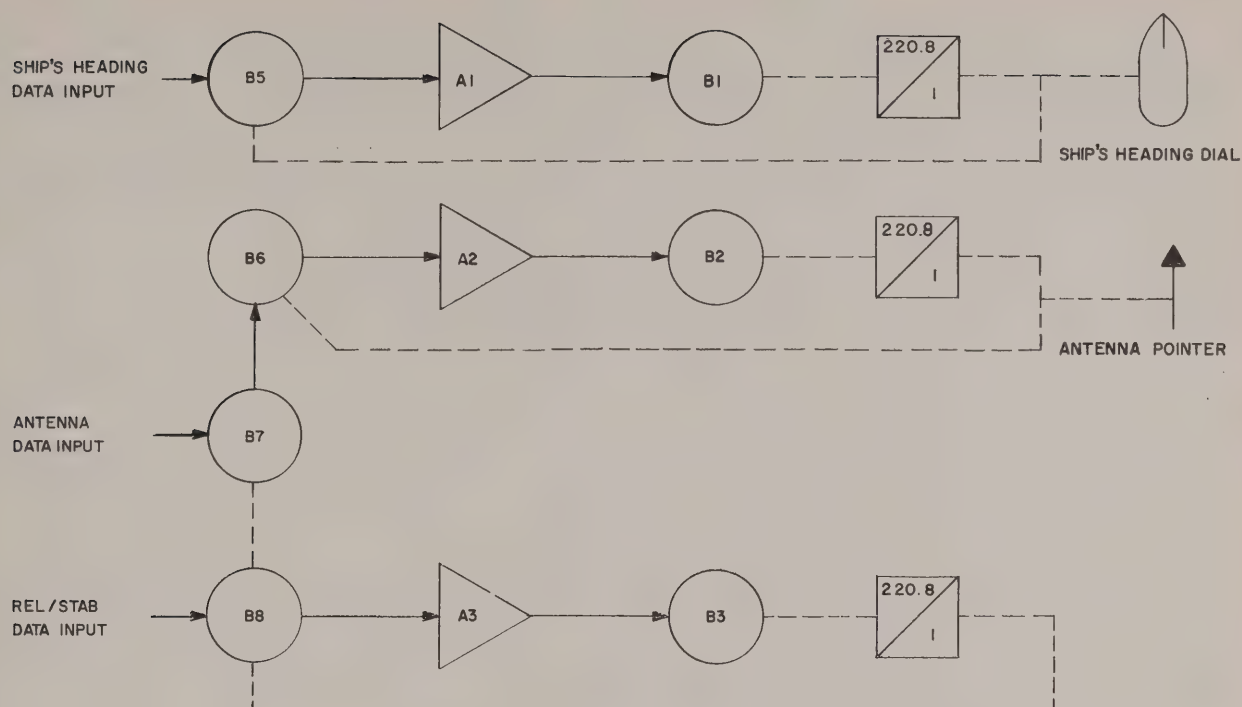


Figure 2-3. Acquisition Bearing Indicator, Block Diagram.

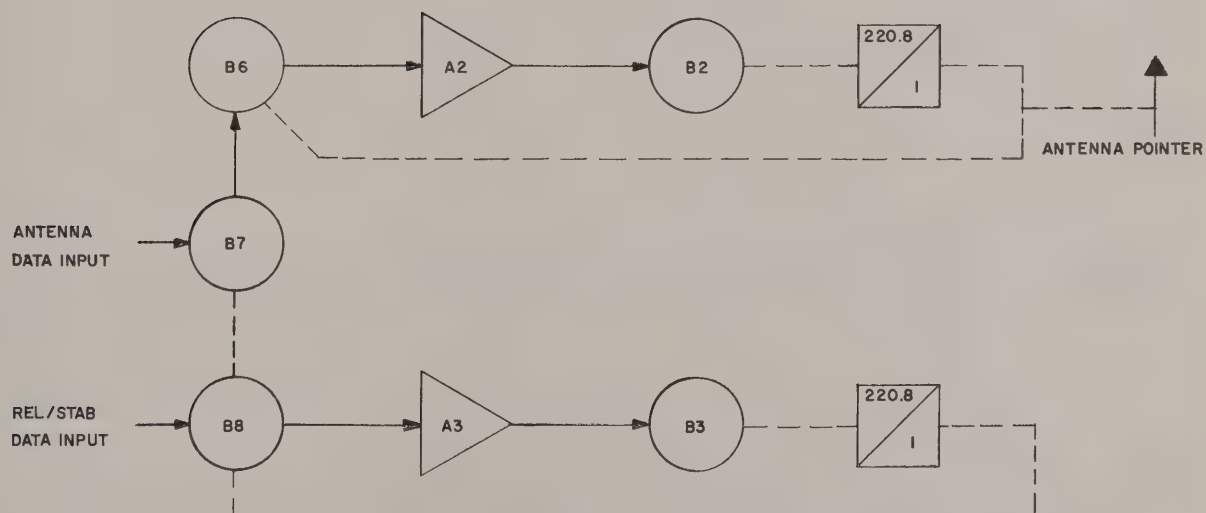


Figure 2-4. Acquisition Elevation Indicator, Block Diagram.

Section II  
Theory of Operation

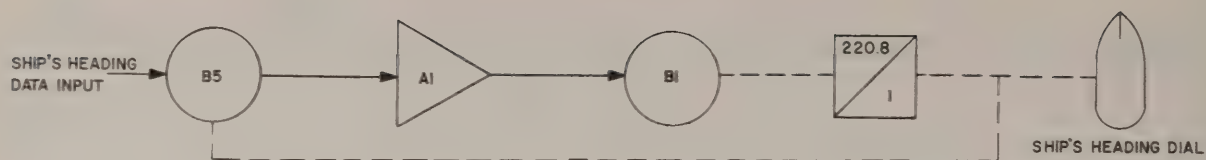


Figure 2-5. Ship's Heading Indicator, Block Diagram.

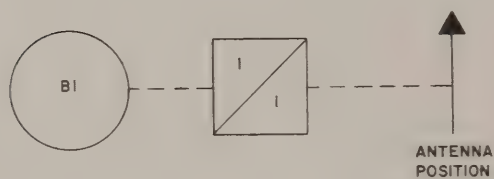


Figure 2-6. Typical Follower-Type Indicator, Block Diagram.

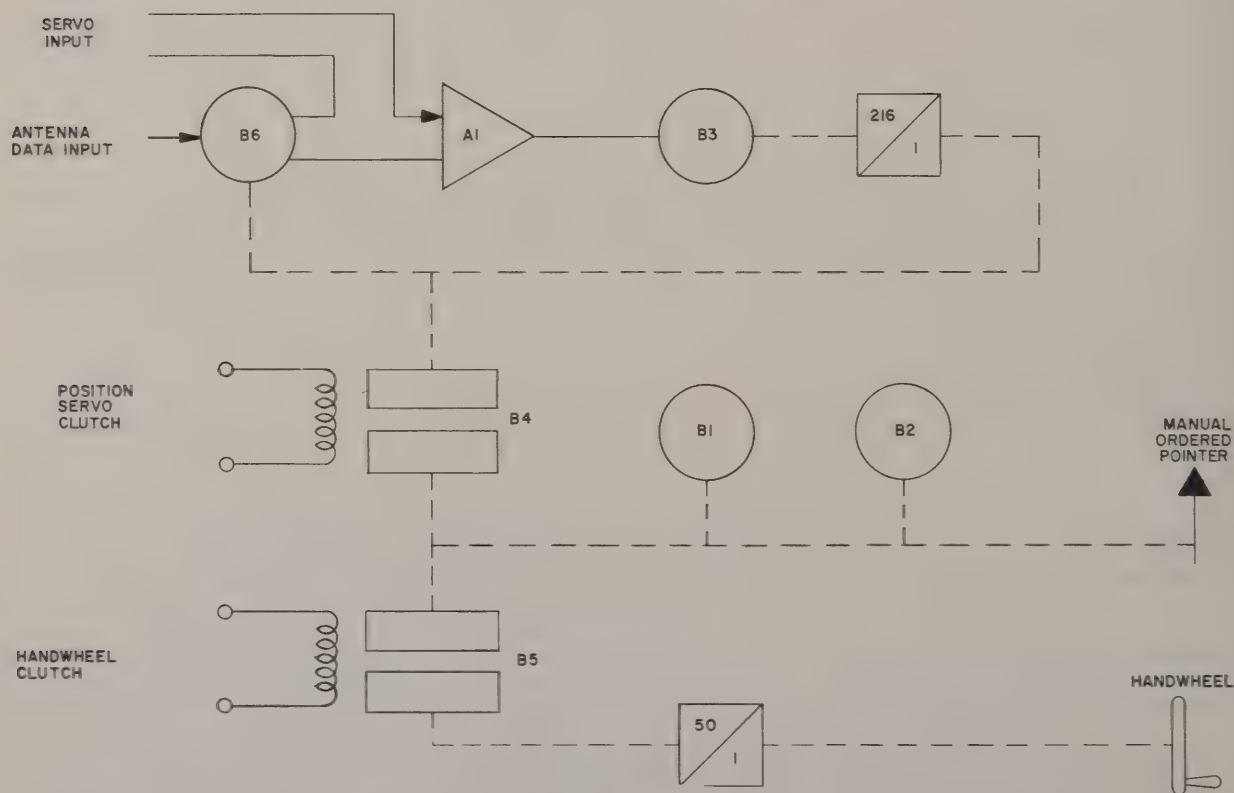


Figure 2-7. Manual Ordered Bearing Indicator and Manual Ordered Elevation Indicator, Block Diagram.



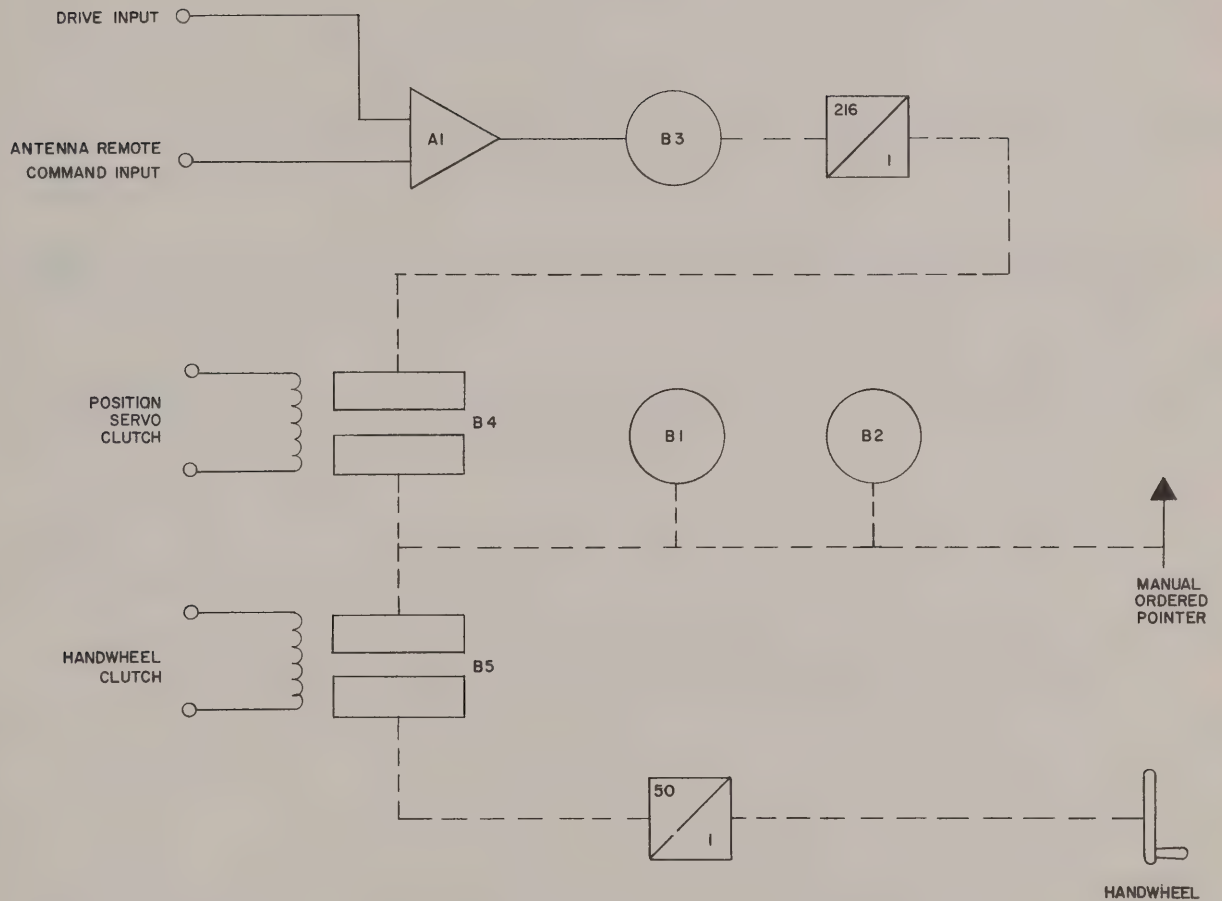


Figure 2-8. Manual Ordered Bearing Indicator - TM2 and Manual Ordered Elevation Indicator - TM2, Block Diagram.

Section II  
Theory of Operation

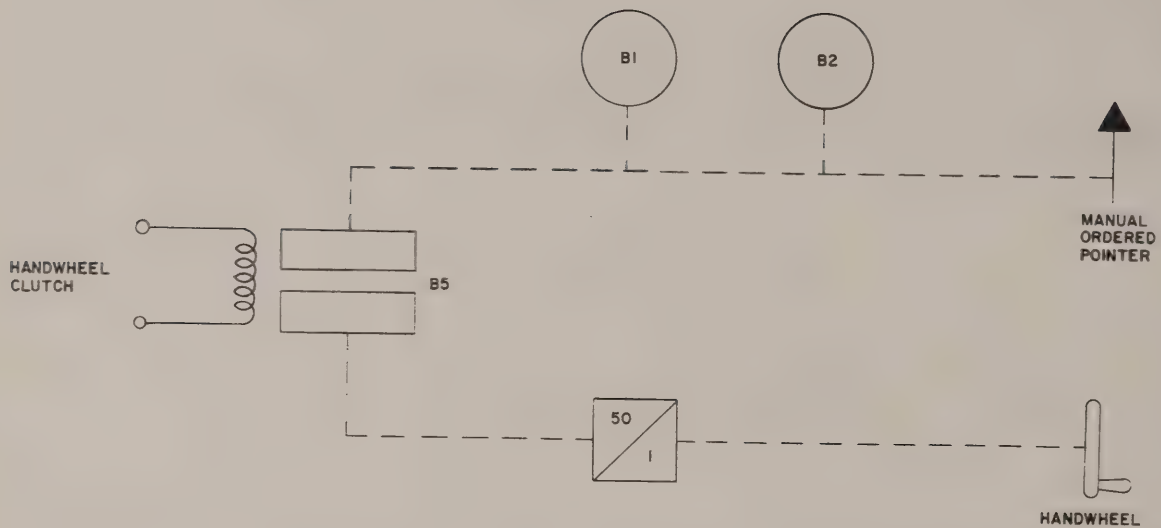


Figure 2-9. Manual Ordered Bearing Indicator - Command Control and Manual Ordered Elevation Indicator - Command Control, Block Diagram.



## SECTION III MAINTENANCE

### 3-1 General.

This section provides information necessary for the maintenance of the antenna position indicators. The information is presented in two categories; preventive maintenance and corrective maintenance.

Preventive maintenance consists of periodic inspections and tests necessary to detect indicator malfunctions. Preventive maintenance also includes routine servicing, such as cleaning and lubrication, necessary to prevent malfunctions of the indicator.

Corrective maintenance involves performance checks, trouble shooting, disassembly and component replacement. Corrective maintenance also includes routine servicing to serviceable indicator components and alignment and associated adjustments.

### 3-2 Tools and Test Equipment.

Tools and test equipment required to maintain the antenna position indicators are listed in Table 3-1. Equivalent equipment may be substituted.

TABLE 3-1. TOOLS AND TEST EQUIPMENT.

Equipment	Manufacturer	Model/Part No.
Oscilloscope	Tektronix	Model 503
Vacuum-Tube Voltmeter	Hewlett-Packard	Model 400D
Multimeter	Simpson	Model 260
Synchro Indexer	Servo Systems	Model TST-103
Test Transmitter	Vernitron	37TX6b
Spray Cleaner	Cobehn	
Indicator Test Set (See Figure 5-1) or equivalent	Superior Mfg.	TE-730
Sandpaper		#000 (Grade)
Lubricant		MIL-L-6085
Grease		MIL-G-3278

Section III  
Maintenance

3-3 Preventive Maintenance.

Preventive maintenance is work performed on equipment, when not in use, to keep it in good working order and minimizing in-service breakdowns. Preventive maintenance and schedules are listed in Table 3-2.

NOTE

Do not overtighten screws when reassembling components. Overtightened hardware may be damaged in removal during indicator disassembly.

TABLE 3-2. PREVENTIVE MAINTENANCE SCHEDULE AND OPERATIONS.

Schedule	Check	Operation
Daily	General Appearance	Clean dial glasses with a soft cloth or lens tissue.
	Indicators	Check operation of indicator lamps.
Monthly	Indicator Components and Connector	Inspect for corrosion. Clean as required.
	Indicator Operation	Check indicator operation. See text for instructions.
Quarterly	Gear Train	Clean and lubricate gears and shafts. See text for instructions.

NOTE

Refer to appropriate subparagraphs of paragraphs 3-8, 3-14, and 3-20 for primary-type, follower-type, and control-type indicator disassembly procedures.

3-4 Cleaning.

3-4.1 General. Use a clean, dry and lint free cloth or a soft brush to remove dust and dirt particles. Use dry compressed air at a pressure of 30 psi to remove dust from inaccessible areas. Use a fine (#000) sandpaper to remove corrosion and tarnish. After sanding, remove dust as described above.

3-4.2 Gear Train. Spray gears, shafts and bearings with Cobeht solvent. Use a soft brush to remove foreign particles not removed by the spray.



### CAUTION

Cobehn solvent is non-toxic but adequate ventilation must be provided when using spray cleaning equipment.

### 3-5 Lubrication.

3-5.1 General. Lubrication of components, except gear trains, is not required and should be avoided. The servomotors and synchro control devices contain sealed bearings and do not require periodic lubrication.

3-5.2 Gear Train. Apply one drop of oil, Specification MIL-L-6085, to each bearing. Apply a thin coating of grease, Specification MIL-G-3278, to the teeth of each gear.

### 3-6 Performance Tests.

The following tests are used to verify proper operation of the antenna position indicators. The tests are to be conducted after prolonged periods of indicator idleness, overhaul, and as scheduled in the recommended preventive maintenance schedule.

### NOTE

The following test procedures are based on the use of the Indicator Test set shown in Figure 5-1. Tests may be conducted with equivalent test equipment substituted for the indicator test set provided the results obtained are comparable with the specified requirements. When using equivalent test equipment this test procedure will serve as a guide.

3-6.1 Synchro Zero Set Procedure. Connect the Synchro Indexer and Test Transmitter to the Indicator Test Set as shown in Figure 5-1. Zero the Test Transmitter to the Synchro Indexer as follows:

- a. Connect the Test Transmitter and the multimeter as shown in Figure 3-1.
- b. Rotate transmitter shaft to the position that produces the smallest voltage reading (approximately 37 volts).
- c. Without rotating the transmitter shaft, reconnect the transmitter and the vacuum-tube voltmeter as shown in Figure 3-2.
- d. Rotate transmitter shaft through the smaller angle that produces the smallest null on the vacuum-tube voltmeter. Set the Synchro Indexer to  $0^\circ$  and couple to the shaft of the Test Transmitter.

3-6.2 Antenna Bearing Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the test set connector J1.

### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

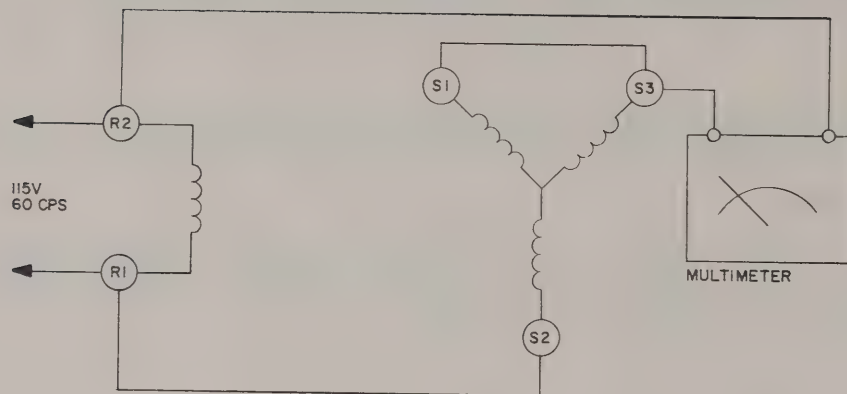


Figure 3-1. Test Transmitter Zeroing Hookup

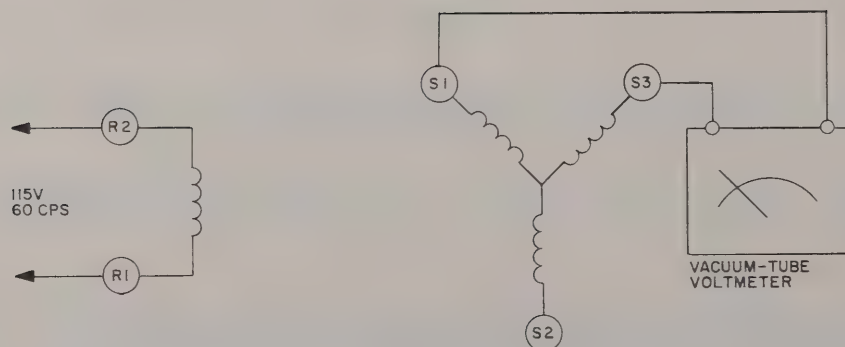


Figure 3-2. Test Transmitter Fine Zeroing Hookup



Proceed with indicator testing as follows:

- a. Set selector switch "A" to position "1", heading switch to "0°" position, and Synchro Indexer to 0°. Apply operating power to the Indicator Test Set. The indicator ANTENNA pointer shall read "N" (North).
- b. Rotate the Synchro Indexer in a positive direction. The indicator ANTENNA pointer shall rotate in a clockwise direction.
- c. Set heading switch to "60°" and Synchro Indexer to 60°. The indicator ANTENNA pointer shall read "120" degrees.
- d. Set selector switch "A" to position "2", heading switch to "0°" position, and Synchro Indexer to 0°. The indicator ORDERED pointer shall read "N" (North).
- e. Rotate the Synchro Indexer in a positive direction. The indicator ORDERED pointer shall rotate in a clockwise direction.
- f. Set heading switch to "60°" and Synchro Indexer to 60°. The indicator ORDERED pointer shall read "120" degrees.
- g. Set selector switch "A" to position "3" and Synchro Indexer to 0°. The indicator ship's heading card shall read "N" (North).
- h. Rotate the Synchro Indexer in a positive direction. The indicator ship's heading card shall rotate in a counter-clockwise direction.
- i. Visually inspect indicator dial for uniform lighting.

### 3-6.3 Antenna Bearing Indicator Scale Error Test.

#### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set selector switch "A" to position "1", heading switch to "0°" position, and Synchro Indexer to 0°. Adjust Synchro Indexer as necessary to position indicator ANTENNA pointer exactly at "N" (0°). The Synchro Indexer shall read  $0^\circ \pm 0.5^\circ$ .
- b. Set selector switch "A" to position "2" and repeat step (a) for the indicator ORDERED pointer.
- c. Repeat steps (a) and (b) for each pointer setting and heading switch position listed in Table 3-3. The Synchro Indexer shall not exceed  $\pm 0.5^\circ$  of nominal setting for required pointer setting.
- d. Set selector switch "A" to position "3" and Synchro Indexer to 0°. Adjust Synchro Indexer as necessary to position indicator ship's heading card exactly at "N" (0°). The Synchro Indexer shall read  $0^\circ \pm 0.5^\circ$ .
- e. Repeat step (d) for each heading card setting listed in Table 3-4. The Synchro Indexer shall not exceed  $\pm 0.5^\circ$  of nominal setting for required card setting.

3-6.4 Antenna Elevation Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the test set connector J1.

TABLE 3-3. ANTENNA BEARING INDICATOR POINTER SCALE ERROR.

Pointer Setting	Heading Switch Set 0°  Synchro Indexer Nom.(°)	Heading Switch Set 60°  Synchro Indexer Nom.(°)	Heading Switch Set 120°  Synchro Indexer Nom.(°)	Heading Switch Set 180°  Synchro Indexer Nom.(°)	Heading Switch Set 240°  Synchro Indexer Nom.(°)	Heading Switch Set 300°  Synchro Indexer Nom.(°)
0°	0	300	240	180	120	60
30°	30	-	-	-	-	-
60°	60	-	-	-	-	-
90°	90	30	330	270	210	150
120°	120	-	-	-	-	-
150°	150	-	-	-	-	-
180°	180	120	160	0	300	240
210°	210	-	-	-	-	-
240°	240	-	-	-	-	-
270°	270	210	150	90	30	330
300°	300	-	-	-	-	-
330°	330	-	-	-	-	-

TABLE 3-4. ANTENNA BEARING INDICATOR HEADING CARD SCALE ERROR.

Heading Card Setting	Synchro Indexer Nom.(°)
0°	0
30°	30
60°	60
90°	90
120°	120
150°	150
180°	180
210°	210
240°	240
270°	270
300°	300
330°	330

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set selector switch "A" to position "1", heading switch to "0°" position, and Synchro Indexer to 0°. Apply operating power to the Indicator Test Set. The indicator ANTENNA pointer shall read "0" degrees.

- b. Rotate the Synchro Indexer in a positive direction. The indicator ANTENNA pointer shall rotate in a clockwise direction.
- c. Set heading switch to "60°" and Synchro Indexer to 30°. The indicator ANTENNA pointer shall read "90°" degrees.
- d. Set selector switch "A" to position "2", heading switch to "0°" position, and Synchro Indexer to 0°. The indicator ORDERED pointer shall read "0°" degrees.
- e. Rotate the Synchro Indexer in a positive direction. The indicator ORDERED pointer shall rotate in a clockwise direction.
- f. Set heading switch to "60°" and Synchro Indexer to 30°. The indicator ORDERED pointer shall read "90°" degrees.
- g. Visually inspect indicator dial for uniform lighting.

### 3-6.5 Antenna Elevation Indicator Scale Error Test.

#### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set selector switch "A" to position "1", heading switch to "0°" position, and Synchro Indexer to 350°. Adjust Synchro Indexer as necessary to position indicator ANTENNA pointer exactly at "-10°" degrees. The Synchro Indexer shall read  $350^\circ \pm 0.5^\circ$ .
- b. Set selector switch "A" to position "2" and repeat step (a) for the indicator ORDERED pointer.
- c. Repeat steps (a) and (b) for each pointer setting and heading switch position listed in Table 3-5. The Synchro Indexer shall not exceed  $\pm 0.5^\circ$  of nominal setting for required pointer setting.

TABLE 3-5. ANTENNA ELEVATION INDICATOR POINTER SCALE ERROR.

Pointer Setting	Heading Switch Set 0° Synchro Indexer Nom.(°)	Heading Switch Set 60° Synchro Indexer Nom.(°)	Heading Switch Set 120° Synchro Indexer Nom.(°)	Heading Switch Set 180° Synchro Indexer Nom.(°)	Heading Switch Set 240° Synchro Indexer Nom.(°)	Heading Switch Set 300° Synchro Indexer Nom.(°)
-10°	250	290	-	-	-	-
0°	0	300	240	180	120	60
30°	30	330	-	-	-	-
60°	60	0	300	240	180	120
90°	90	30	-	-	-	-
110°	110	50	350	290	230	170



3-6.6 Manual Ordered Bearing Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to test set connector J2.

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

Proceed with indicator testing as follows:

- a. Set selector switch "B" to position "1", clutch switch to "REMOTE", and slew switch to "OPERATE". Apply operating power to the Indicator Test Set.
- b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.
- c. Set slew switch to "SLEW". Rotate slew control in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- d. Set clutch switch to "MANUAL". Rotate indicator handwheel in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- e. Adjust indicator handwheel until the indicator pointer reads "0" degrees. Set transmitter switch to "CDX" and null selector to "0°". The indicator CDX output shall be less than 250 millivolts as observed on an oscilloscope.
- f. Set transmitter switch to "TX". The indicator TX output shall be less than 250 millivolts as observed on the oscilloscope.
- g. Set clutch switch to "OFF" and slew switch to "OPERATE". Rotation of either the indicator handwheel or the Synchro Indexer shall not cause the indicator pointer to rotate.
- h. Visually inspect the indicator dial for uniform lighting.

3-6.7 Manual Ordered Bearing Indicator Scale Error Test.

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set selector switch "B" to position "1", clutch switch to "REMOTE", and set both null selector switch and Synchro Indexer to 0°.
- b. Set transmitter selector respectively to "CDX" and "TX". The indicator CDX and TX output shall not exceed 250 millivolts as observed on the oscilloscope.
- c. Repeat steps (a) and (b) with both null selector and Synchro Indexer set at the following test points: 60°, 120°, 180°, 240° and 300°. The indicator CDX and TX output shall not exceed 250 millivolts at any test point.
- d. Set Synchro Indexer to 0°, null selector at "60°", and transmitter selector to "TX". After the indicator pointer has come to a complete rest, turn off operating power to the Indicator Test Set.

e. Reset Synchro Indexer to 60° and reapply operating power to the Indicator Test Set. The indicator shall not exhibit more than two overshoots, as observed on the oscilloscope, during stabilization at 60°.

3-6.8 Manual Ordered Elevation Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to test set connector J2.

#### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

Proceed with indicator testing as follows:

- a. Set selector switch "B" to position "1", clutch switch to "REMOTE", and slew switch to "OPERATE". Apply operating power to the Indicator Test Set.
- b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.
- c. Set slew switch to "SLEW". Rotate slew control in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- d. Set clutch switch to "MANUAL". Rotate indicator handwheel in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- e. Adjust indicator handwheel until the indicator pointer reads "0" degrees. Set transmitter to "CDX" and null selector to "0°". The indicator CDX output shall be less than 250 millivolts as observed on an oscilloscope.
- f. Set transmitter switch to "TX". The indicator TX output shall be less than 250 millivolts as observed on the oscilloscope.
- g. Set clutch switch to "OFF" and slew switch to "OPERATE". Rotation of either the indicator handwheel or the Synchro Indexer shall not cause the indicator pointer to rotate.
- h. Visually inspect the indicator dial for uniform lighting.

3-6.9 Manual Ordered Elevation Indicator Scale Error Test.

#### NOTE

The indicator shall be vibrated or lightly tapped with a pencil before taking test readings.

- a. Set selector switch "B" to position "1", clutch switch to "REMOTE", and set both null selector and Synchro Indexer to 0°.
- b. Set transmitter selector respectively to "CDX" and "TX". The indicator CDX and TX output shall not exceed 250 millivolts as observed on the oscilloscope.
- c. Repeat steps (a) and (b) with both null selector and Synchro Indexer set at 60°. The indicator CDX and TX output shall not exceed 250 millivolts.

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3-6.10 Bearing Limit Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the limit indicator terminals "R1", "R2", "S1", "S2", and "S3". Make connections from the test set directly to the indicator synchro torque receiver. Proceed with indicator testing as follows:

- a. Set Synchro Indexer to  $0^{\circ}$ . Apply operating power to the Indicator Test Set. The indicator pointer shall read "0" degrees.
- b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.
- c. Visually inspect the indicator dial for uniform lighting.

3-6.11 Bearing Limit Indicator Scale Error Test.

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set the Synchro Indexer to  $0^{\circ}$ . Adjust the Synchro Indexer as necessary to position the indicator pointer exactly at "0" degrees. The Synchro Indexer shall read  $0^{\circ} \pm 1.0^{\circ}$ .
- b. Repeat step (a) for each pointer setting listed in Table 3-6. The Synchro Indexer shall not exceed  $+1.0^{\circ}$  of nominal for required pointer setting.

TABLE 3-6. BEARING LIMIT INDICATOR SCALE ERROR

Pointer Setting ( $^{\circ}$ )	Synchro Indexer Nom. ( $^{\circ}$ )
0	0
60	60
120	120
180	180
240	240
300	300
360	360
420	60
480	120
540	180
-120	240
-60	300

- c. Check fiducial marker adjustment travel to be from  $+170^{\circ}$  to  $+530^{\circ}$ .

3-6.12 Elevation Limit Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the limit indicator terminals "R1", "R2", "S1", "S2", and "S3". Make connections from the test set directly to the indicator synchro torque receiver. Proceed with indicator testing as follows:



- a. Set Synchro Indexer to  $0^{\circ}$ . Apply operating power to the Indicator Test Set. The indicator pointer shall read "0" degrees.
- b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.
- c. Visually inspect the indicator dial for uniform lighting.

### 3-6.13 Elevation Limit Indicator Scale Error Test.

#### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set the Synchro Indexer to  $-15^{\circ}$ . Adjust the Synchro Indexer as necessary to position the indicator pointer exactly at  $-15^{\circ}$  degrees. The Synchro Indexer shall read  $-15^{\circ} \pm 1.0^{\circ}$ .
- b. Repeat step (a) for each pointer setting listed in Table 3-7. The Synchro Indexer shall not exceed  $\pm 1.0^{\circ}$  of nominal for required pointer setting.

TABLE 3-7. ELEVATION LIMIT INDICATOR SCALE ERROR

Pointer Setting ( $^{\circ}$ )	Synchro Indexer Nom. ( $^{\circ}$ )
-15	-15
0	0
30	30
60	60
90	90
95	95

3-6.14 Acquisition Bearing Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the test set connector J1. Proceed with indicator testing as follows:

- a. Set selector switch "A" to position "1", heading switch to "0" position, and Synchro Indexer to  $0^{\circ}$ . Apply operating power to the Indicator Test Set. The indicator pointer shall read "N" (North).
- b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.
- c. Set heading switch to "60" and Synchro Indexer to  $60^{\circ}$ . The indicator pointer shall read "120" degrees.
- d. Set selector switch "A" to position "3" and Synchro Indexer to  $0^{\circ}$ . The indicator ship's heading card shall read "N" (North).

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e. Rotate the Synchro Indexer in a positive direction. The indicator ship's heading card shall rotate in a counter-clockwise direction.

f. Visually inspect indicator dial for uniform lighting.

#### 3-6.15 Acquisition Bearing Indicator Scale Error Test.

##### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

a. Set selector switch "A" to position "1", heading switch to "0°" position, and Synchro Indexer to 0°. Adjust Synchro Indexer as necessary to position indicator pointer exactly at "N" (0°). The Synchro Indexer shall read  $0^\circ \pm 0.5^\circ$ .

b. Repeat step (a) for each pointer setting and heading switch position listed in Table 3-3. The Synchro Indexer shall not exceed  $\pm 0.5^\circ$  of nominal setting for required pointer setting.

c. Set selector switch "A" to position "3" and Synchro Indexer to 0°. Adjust Synchro Indexer as necessary to position indicator ship's heading card exactly at "N" (0°). The Synchro Indexer shall read  $0^\circ \pm 0.5^\circ$ .

d. Repeat step (c) for each heading card setting listed in Table 3-4. The Synchro Indexer shall not exceed  $\pm 0.5^\circ$  of nominal setting for required card setting.

3-6.16 Acquisition Elevation Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the test set connector J1. Proceed with testing as follows:

a. Set selector switch "A" to position "1", heading switch to "0°" position, and Synchro Indexer to 0°. Apply operating power to the Indicator Test Set. The indicator pointer shall read "0" degrees.

b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.

c. Set heading switch to "60°" and Synchro Indexer to 30°. The indicator pointer shall read "90" degrees.

d. Visually inspect indicator dial for uniform lighting.

#### 3-6.17 Acquisition Elevation Indicator Scale Error Test.

##### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

a. Set Selector switch "A" to position "1", heading switch to "0°" position, and Synchro Indexer to 350°. Adjust Synchro Indexer as necessary to position indicator exactly at "-10" degrees. The Synchro Indexer shall read  $350^\circ \pm 0.5^\circ$ .

b. Repeat step (a) for each pointer setting and heading switch position listed in Table 3-5. The Synchro Indexer shall not exceed  $\pm 0.5^\circ$  of nominal setting for required pointer setting.

3-6.18 Ship's Heading Indicator Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to test set connector J1. Proceed with indicator testing as follows:

- a. Set selector switch "A" to position "3" and Synchro Indexer to  $0^{\circ}$ . The indicator ship's heading card shall read "N" (North).
- b. Rotate the Synchro Indexer in a positive direction. The indicator ship's heading card shall rotate in a counter-clockwise direction.
- c. Visually inspect indicator dial for uniform lighting.

3-6.19 Ship's Heading Indicator Scale Error Test.

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set Selector switch "A" to position "3" and Synchro Indexer to  $0^{\circ}$ . Adjust Synchro Indexer as necessary to position indicator ship's heading card exactly at "N" ( $0^{\circ}$ ). The Synchro Indexer shall read  $0^{\circ} \pm 0.5^{\circ}$ .
- b. Repeat step (a) for each heading card setting listed in Table 3-4. The Synchro Indexer shall not exceed  $\pm 0.5^{\circ}$  of nominal setting for required card setting.

3-6.20 Bearing Limit Indicator - Command Control - Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the limit indicator terminals "R1", "R2", "S1", "S2", and "S3". Make connections from the test set directly to the indicator synchro torque receiver. Proceed with indicator testing as follows:

- a. Set Synchro Indexer to  $0^{\circ}$ . Apply operating power to the Indicator Test Set. The indicator pointer shall read "0" degrees.
- b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.
- c. Visually inspect the indicator dial for uniform lighting.

3-6.21 Bearing Limit Indicator - Command Control - Scale Error Test.

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set the Synchro Indexer to  $0^{\circ}$ . Adjust the Synchro Indexer as necessary to position the indicator pointer exactly at "0" degrees. The Synchro Indexer shall read  $0^{\circ} \pm 1.0^{\circ}$ .
- b. Repeat step (a) for each pointer setting listed in Table 3-8. The Synchro Indexer shall not exceed  $\pm 1.0^{\circ}$  of nominal for required pointer setting.

3-6.22 Elevation Limit Indicator - Command Control - Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the limit indicator



TABLE 3-8. BEARING LIMIT INDICATOR - COMMAND CONTROL SCALE ERROR

Pointer Setting (°)	Synchro Indexer Nom. (°)
0	0
120	60
240	120
-240	240
-120	300

terminals "R1", "R2", "S1", "S2", and "S3". Make connections from the test set directly to the indicator synchro torque receiver. Proceed with indicator tests as follows:

- a. Set the Synchro Indexer to 0°. Apply operating power to the Indicator Test Set. The indicator pointer shall read "0" degrees.
- b. Rotate the Synchro Indexer in a positive direction. The indicator pointer shall rotate in a clockwise direction.
- c. Visually inspect the indicator dial for uniform lighting.

#### 3-6.23 Elevation Limit Indicator - Command Control - Scale Error Test.

#### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set the Synchro Indexer to -13°. Adjust the Synchro Indexer as necessary to position the indicator pointer exactly at "-13" degrees. The Synchro Indexer shall read  $-13^\circ \pm 1.0^\circ$ .
- b. Repeat step (a) for each pointer setting listed in Table 3-9. The Synchro Indexer shall not exceed  $\pm 1.0^\circ$  of nominal for required pointer setting.

TABLE 3-9. ELEVATION LIMIT INDICATOR - COMMAND CONTROL - SCALE ERROR

Pointer Setting (°)	Synchro Indexer Nom. (°)
-13	-13
0	0
30	30
60	60
90	90
113	113

3-6.24 Manual Ordered Bearing Indicator - TM2 - Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to the set connector J2. Proceed with indicator testing as follows:

- a. Set selector switch "B" to "OFF" position, clutch switch to "REMOTE", and slew switch to "SLEW". Apply operating power to the Indicator Test Set.
- b. Rotate slew control in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- c. Set clutch switch to "MANUAL". Rotate indicator handwheel in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- d. Adjust indicator handwheel until the indicator pointer reads "0" degrees. Set transmitter switch to "CDX" and null selector to "0°". The indicator CDX output shall be less than 250 millivolts as observed on an oscilloscope.
- e. Set transmitter switch to "TX". The indicator TX output shall be less than 250 millivolts as observed on the oscilloscope.
- f. Set clutch switch to "OFF" and slew switch to "SLEW". Rotation of either the indicator handwheel or the slew control shall not cause the indicator pointer to rotate.
- g. Visually inspect the indicator dial for uniform lighting.

3-6.25 Manual Ordered Bearing Indicator - TM2 - Scale Error Test.

#### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set selector switch "B" to "OFF" position, clutch switch to "MANUAL", set null selector to 0°, and adjust indicator handwheel for a reading of "0" degrees on indicator dial.
- b. Set transmitter switch respectively to "CDX" and "TX". The indicator CDX and TX output shall not exceed 250 millivolts as observed on the oscilloscope.
- c. Repeat steps (a) and (b) with both the null selector and indicator pointer set at the following test points: 60°, 120°, 180°, 240° and 300°. The indicator CDX and TX output shall not exceed 250 millivolts at any test point.

3-6.26 Manual Ordered Elevation Indicator - TM2 - Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to test set connector J2. Proceed with indicator testing as follows:

- a. Set selector switch "B" to "OFF" position, clutch switch to "REMOTE", and slew switch to "SLEW". Apply operating power to the Indicator Test Set.
- b. Rotate slew control in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- c. Set clutch switch to "MANUAL". Rotate indicator handwheel in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- d. Adjust indicator handwheel until the indicator pointer reads "0" degrees. Set transmitter switch to "CDX" and null selector to "0°". The indicator CDX output shall be less than 250 millivolts as observed on an oscilloscope.

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- e. Set transmitter switch to "TX". The indicator TX output shall be less than 250 millivolts as observed on the oscilloscope.
- f. Set clutch switch to "OFF" and slew switch to "SLEW". Rotation of either the indicator handwheel or the slew control shall not cause the indicator pointer to rotate.
- g. Visually inspect the indicator dial for uniform lighting.

3-6.27 Manual Ordered Elevation Indicator - TM2 - Scale Error Test.

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set selector switch "B" to "OFF" position, clutch switch to "MANUAL", set null selector to 0°, and adjust indicator handwheel for a reading of "0" degrees on indicator dial.
- b. Set transmitter switch respectively to "CDX" and "TX". The indicator CDX and TX output shall not exceed 250 millivolts as observed on the oscilloscope.
- c. Repeat steps (a) and (b) with both the null selector and indicator pointer set at 60°. The indicator CDX and TX output shall not exceed 250 millivolts.

3-6.28 Manual Ordered Bearing Indicator - Command Control - Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to test set connector J2. Proceed with indicator testing as follows:

- a. Set selector switch "B" to "OFF" position and clutch switch to "MANUAL". Apply operating power to the Indicator Test Set.
- b. Rotate indicator handwheel in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- c. Adjust indicator handwheel until the indicator pointer reads "0" degrees. Set transmitter switch to "CDX" and null selector to "0°". The indicator CDX output shall be less than 250 millivolts as observed on an oscilloscope.
- d. Set transmitter switch to "TX". The indicator TX output shall be less than 250 millivolts as observed on the oscilloscope.
- e. Set clutch switch to "OFF". Rotation of the indicator handwheel shall not cause the indicator pointer to rotate.
- f. Visually inspect the indicator dial for uniform lighting.

3-6.29 Manual Ordered Bearing Indicator - Command Control - Scale Error Test.

NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.



- a. Set selector switch "B" in "OFF" position, clutch switch to "MANUAL", set null selector to 0°, and adjust indicator handwheel for a reading of "0" degrees on indicator dial.
- b. Set transmitter switch respectively to "CDX" and "TX". The indicator CDX and TX output shall not exceed 250 millivolts as observed on the oscilloscope.
- c. Repeat steps (a) and (b) with both the null selector and indicator pointer set at the following test points: 60°, 120°, 180°, 240° and 300°. The indicator CDX and TX output shall not exceed 250 millivolts at any test point.

3-6.30 Manual Ordered Elevation Indicator - Command Control - Functional Tests. Remove operating power from the Indicator Test Set, Figure 5-1, and connect the indicator to test set connector J2. Proceed with indicator testing as follows:

- a. Set selector switch "B" to "OFF" position, and clutch switch to "MANUAL". Apply operating power to the Indicator Test Set.
- b. Rotate indicator handwheel in both directions. The indicator pointer shall rotate in both clockwise and counter-clockwise directions.
- c. Adjust indicator handwheel until the indicator pointer reads "0" degrees. Set transmitter switch to "CDX" and null selector to 0°. The indicator CDX output shall not exceed 250 millivolts as observed on an oscilloscope.
- d. Set transmitter switch to "TX". The indicator TX output shall not exceed 250 millivolts as observed on the oscilloscope.
- e. Set clutch switch to "OFF". Rotation of the indicator handwheel shall not cause the indicator pointer to rotate.
- f. Visually inspect the indicator dial for uniform lighting.

3-6.31 Manual Ordered Elevation Indicator - Command Control - Scale Error Test.

#### NOTE

The indicator shall be vibrated or lightly tapped with a lead pencil before taking test readings.

- a. Set selector switch "B" in "OFF" position, clutch switch to "MANUAL", set null selector to 0° and adjust indicator handwheel for a reading of "0" degrees on indicator dial.
- b. Set transmitter switch respectively to "CDX" and "TX". The indicator CDX and TX output shall not exceed 250 millivolts as observed on the oscilloscope.
- c. Repeat steps (a) and (b) with both the null selector and indicator pointer set at 60°. The indicator CDX and TX output shall not exceed 250 millivolts.

3-7 Corrective Maintenance. Corrective Maintenance is work performed on malfunctioning or damaged equipment to restore it to good working order. This work consists of indicator disassembly, component checkout, component repair or replacement, indicator reassembly, and alignment. Upon completion of corrective repair, the indicator shall be tested for operation and accuracy in accordance with instructions for the particular indicator in paragraphs 3-6.2 through 3-6.31.

Orthographic views are provided each antenna position indicator assembly showing their associated subassemblies. The numerical callouts placed about the illustrations identify parts which

are to be disassembled and the sequence in which they are to be removed. Avoid unnecessary disassembly. Disassemble the indicator only to the extent necessary to effect proper repair.

Due to close similarities between indicator types, disassembly procedures have been arranged to provide disassembly sequences according to indicator types. Paragraphs 3-8 through 3-13 provide disassembly and overhaul information for the primary-type indicators. Paragraphs 3-14 through 3-19 provide disassembly and overhaul information for the follower-type indicators. Paragraphs 3-20 through 3-25 provide disassembly and overhaul information for the control-type indicators.

3-8 Primary-Type Indicator Overhaul. The Antenna Bearing Indicator, Antenna Elevation Indicator, Acquisition Bearing Indicator, Acquisition Elevation Indicator, and Ship's Heading Indicator are primary-type indicators. Refer to Figure 5-2 and proceed to disassemble the indicator as follows:

- a. Remove four outer screws (1) and lockwashers (2) from rear of indicator housing.
- b. Remove eight screws (3) from sides of indicator housing. Carefully slide housing (4) from indicator assembly.

#### NOTE

Do not disassemble dial glass and flange assembly unless to replace a damaged dial glass. To remove dial glass, remove eight screws (5) from flange assembly and separate front cover (6) from flange (7). Use care not to damage or distort dial glass gaskets (8) and (9) during cover and flange operation.

- c. Mask dial glass and flange assembly for protection during remainder of indicator overhaul.
- d. Remove four screws (10) from electrical assembly mounting plate. The electrical assembly (12) is now free of the mechanical assembly (11) except for the interconnecting wire harness.
- e. Remove (unscrew) four posts (13) from mechanical assembly. Carefully separate dial glass from flange assembly from the mechanical assembly.

#### 3-8.1 Indicator Light Ring and Lamp Disassembly.

#### NOTE

If indicator light ring and/or lamps do not require replacement disregard this paragraph and proceed to paragraph 3-8.2.

- a. Remove four screws (1, Figure 5-3) from indicator light ring (2). Carefully lift off light ring from dial posts (3).

#### CAUTION

The indicator light ring is fragile. The four printed circuit lamp boards (4) should separate

easily from the light ring. Use care when separating the boards from the light ring and when reassembling the light ring to the indicator assembly. Do not overtighten the four screws (1) as the ring may crack with too much pressure.

### 3-8.2 Pointer, Dial and Gear Train Disassembly.

#### NOTE

If the indicator gear train does not require disassembly and if the pointer(s) and/or dial do not require replacement disregard this paragraph and proceed to paragraph 3-8.3.

a. Apply equal circumferential pressure around the ORDERED pointer (if applicable) and pull pointer (5) from pointer shaft.

b. Apply equal circumferential pressure around the ANTENNA pointer (if applicable) and pull pointer (6) from pointer shaft.

#### NOTE

The Acquisition Elevation Indicator pointer is clamped to the pointer shaft. Loosen clamp (7) for pointer removal.

c. Remove three screws (8) from ship's heading card (9) and carefully lift off card.

d. Remove three screws (10) and carefully remove dial (11) from dial plate.

e. Remove three screws (12) and carefully remove dial plate (13) from mechanical assembly.

f. Loosen clamp (14) and remove gear (15) from mechanical assembly.

g. Remove retaining ring (16) and remove card drive gear (17) from mechanical assembly.

h. Remove three screws (18) and carefully remove front gear plate from mechanical assembly. DO NOT REMOVE GEAR ASSEMBLIES FROM REAR PLATE UNTIL TAGGED WITH POSITION NUMBERS GIVEN IN FIGURE 5-4 FOR IDENTIFICATION DURING REASSEMBLY.

3-8.3 Electronic Assembly. The electronic assembly, see Figure 5-5, contains all the electrical and electronic components and assemblies of the indicator except for the synchros and servomotors. Schematic diagrams for each primary-type indicator are given in Figures 5-6 through 5-10. Each indicator contains one power supply, see Figures 5-11 and 5-12, and from one to four amplifiers, see Figures 5-13 and 5-14.

3-8.4 Power Supply Checkout. The power supply schematic diagram, see Figure 5-12, lists voltage checkpoints to assist in checkout of the supply. A 30-ohm load with a rating of 30 watts must be connected across resistor R5, the supply output, if the power supply has been removed from the indicator for trouble shooting.

3-8.5 Amplifier Checkout. The amplifier schematic diagram, see Figure 5-14, lists both quiescent DC and non-quiescent AC voltage checkpoints to assist in checkout of the amplifier.



## Section III Maintenance

A size 15 servomotor must be connected to the amplifier output as shown in Figure 5-14 to provide the required amplifier load. The servomotor reference phase field is not to be connected to 115 volts during amplifier testing. The listed test point voltages are of nominal value. Amplifier gain must produce an output of 12 volts, peak-to-peak,  $\pm 2$  volts across amplifier terminals 4 and 5.

### 3-8.6 Inspection, Cleaning, and Lubrication.

a. Inspection. Inspect indicator components for excessive wear, cracks, deformation, and discoloration from excessive heat. Discard and replace all suspect components that may impair the operation of the indicator.

b. Cleaning. Clean indicator components as follows:

(1) Wash dial glass in mild detergent solution. Rinse in clean water and dry with a soft cloth or lens tissue.

(2) Clean dial, pointer assemblies, and light ring assembly with a soft cloth - use extreme care not to scratch painted surfaces.

(3) Spray gears, shafts, and bearings with Cobehn solvent. Use a soft brush to remove foreign particles not removed by the spray.

(4) Clean remainder of indicator components with clean dry compressed air.

c. Lubrication. Apply one drop of oil, Specification MIL-L-6085, to each bearing. Apply a thin coating of grease, Specification MIL-G-3278, to the teeth of each gear. The servomotors and synchro control devices contain sealed bearings and do not require lubrication.

3-8.7 Lamp Replacement. The indicator uses eight lamps, two lamps per printed circuit board, for indicator illumination. The lamps are of the 28-volt type and are connected in a parallel-series arrangement with four lamps in each series leg.

a. Isolate printed circuit boards with defective lamps by applying 24 volts across each lamp. Serviceable lamps will glow as voltage is applied to each lamp.

b. Unsolder the red and black leads to each printed circuit board containing a defective lamp. Remove and discard defective printed circuit boards.

c. Install new printed circuit boards in place of discarded boards and retest lamp circuit as described in paragraph (a).

3-8.8 Indicator Reassembly. Indicator assembly is essentially the reverse of disassembly.

#### NOTE

Do not overtighten screws when reassembling components. Overtightened hardware may be damaged in removal during indicator disassembly.

### 3-8.9 Indicator Alignment.

a. Ship's Heading Card Alignment.

(1) Install ship's heading card (9, Figure 5-3) on card drive gear (15).

(2) Connect indicator to Indicator Test Set connector J1, see Figure 5-1.

(3) Set selector switch "A" to position "1" and apply operating power to the test set. Allow card to come to a complete rest.

(4) Loosen indicator synchro R5 clamps and rotate synchro housing until ship's heading card reads "N" on indicator dial. Lightly tap indicator with a lead pencil to remove any friction error and then retighten clamps.

(5) Set selector switch "A" to position "3" and Synchro Indexer to 0°. Check the ship's heading card to read "N". Rotate Synchro Indexer in a positive direction until the ship's card reads "W" on indicator dial.

(6) Reset selector switch "A" to position "1". Check the ship's heading card to return and read "N" on indicator dial. Reposition synchro housing as necessary for an exact reading and repeat steps (4) through (6) to check card accuracy.

b. Antenna Pointer Alignment.

(1) Connect indicator to Indicator Test Set connector J1, see Figure 5-1.

(2) Set selector switch "A" to position "2" and heading switch to "0°" position. Allow indicator synchros to come to a complete rest.

(3) Lightly tap indicator with a lead pencil to remove any friction error and install ANTENNA pointer (6, Figure 5-3) on pointer shaft to read "N" on indicator dial.

(4) Set selector switch "A" to position "1", Synchro Indexer to 30°, and heading switch to "60°". Check ANTENNA pointer to read "E" on indicator dial.

(5) Reset selector switch "A" to position "2" and heading switch to "0°" position. Check ANTENNA pointer to read "N" on indicator dial. Reposition pointer on shaft as necessary for an exact reading.

c. Ordered Pointer Alignment.

(1) Set selector switch "A" to position "1" and heading switch to "0°" position. Allow indicator synchros to come to a complete rest.

(2) Lightly tap indicator with a lead pencil to remove any friction error and install ORDERED pointer (5, Figure 5-3) on pointer shaft to read "N" on indicator dial.

(3) Set selector switch "A" to position "2", Synchro Indexer to 30°, and heading switch to "60°". Check ORDERED pointer to read "E" on indicator dial.

(4) Reset selector switch "A" to position "1" and heading switch to "0°" position. Check ORDERED pointer to read "N" on indicator dial. Reposition pointer on shaft as necessary for an exact reading.

3-8.10 Indicator Test. Test the indicator for operation and scale error as outlined under Performance Tests, paragraph 3-6, in this section.

3-9 Follower-Type Indicator Overhaul. The Bearing Limit Indicator, Elevation Limit Indicator, Bearing Limit Indicator - Command Control, and Elevation Limit Indicator - Command Control are follower-type indicators. Refer to Figure 5-15 and proceed to disassemble the indicator as follows:

a. Remove eight screws (1) from indicator mounting bezel. Separate front bezel (2) from indicator assembly.

### Section III Maintenance

- b. Remove dial glass (3) and gaskets (4) and (5) from indicator assembly. Do not discard gaskets unless deformed or damaged.
- c. Remove four screws (6) and lockwashers (7) from indicator assembly. Carefully separate rear bezel (8) from indicator assembly.
- d. Remove four screws (9) from light ring assembly (10). Carefully separate light ring assembly from indicator assembly.

#### NOTE

The Bearing Limit Indicator incorporates a fiducial marker which must be removed at this point of indicator disassembly. Remove two screws (11) from fiducial marker (12) and remove marker from marker bracket (13).

- e. Loosen four setscrews (14) and carefully pull pointer (15) from synchro receiver shaft.
- f. Remove three screws (16) from dial face and carefully remove dial (17) from indicator assembly.
- g. Remove four synchro clamps and screws (18) and remove synchro receiver from indicator assembly.

#### NOTE

Further disassembly of the indicator is not necessary.

#### 3-9.1 Inspection, Cleaning, and Lubrication.

a. Inspection. Inspect indicator components for excessive wear, cracks, deformation, and discoloration from excessive heat. Discard and replace all suspect components that may impair the operation of the indicator.

b. Cleaning. Clean indicator components as follows:

- (1) Wash dial glass in mild detergent solution. Rinse in clean water and dry with a soft cloth or lens tissue.
- (2) Clean dial, pointer, and light ring assembly with a soft cloth - use extreme care not to scratch painted surfaces.
- (3) Clean remainder of indicator components with clean dry compressed air.

c. Lubrication. The synchro receiver does not require lubrication.

3-9.2 Lamp Replacement. The indicator uses eight lamps, two lamps per printed circuit board, for indicator illumination. The lamps are of the 28-volt type and are connected in a parallel-series arrangement with four lamps in each series leg.

a. Isolate printed circuit boards with defective lamps by applying 24 volts across each lamp. Serviceable lamps will glow as voltage is applied to each lamp.



b. Unsolder the red and black leads to each printed circuit board containing a defective lamp. Remove and discard defective printed circuit boards.

c. Install new printed circuit boards in place of discarded boards and retest lamp circuit as described in paragraph (a).

3-9.3 Indicator Reassembly. Indicator reassembly is essentially the reverse of disassembly.

#### NOTE

Do not overtighten screws when reassembling components. Overtightened hardware may be damaged in removal during indicator disassembly.

3-9.4 Indicator Zeroing. Zero the follower-type indicator synchro receiver in accordance with instructions given in paragraph 3-6 for the Test Transmitter. Substitute "indicator synchro receiver" for "transmitter" where referred to in subparagraphs (a) through (d). Install the indicator pointer to read "0°" on the indicator dial when the receiver shaft angle produces the smallest null on the vacuum-tube voltmeter.

3-9.5 Indicator Test. Test the indicator for operation and scale error as outlined under Performance Tests, paragraph 3-6, in this section.

3-10 Control-Type Indicator Overhaul. The Manual Ordered Bearing Indicator, Manual Ordered Elevation Indicator, Manual Ordered Bearing Indicator - TM2, Manual Ordered Elevation Indicator - TM2, Manual Ordered Bearing Indicator - Command Control, and Manual Ordered Elevation Indicator - Command Control are control-type indicators. Refer to Figure 5-17 and proceed to disassemble the indicator as follows:

- a. Remove four outer screws (1) and lockwashers (2) from rear of indicator housing.
- b. Remove eight screws (3) from sides of indicator housing. Carefully slide housing (4) from indicator assembly.

#### NOTE

Do not disassemble dial glass and flange assembly unless to replace a damaged dial glass. To remove dial glass, loosen handwheel (5) setscrew and remove handwheel and tension ring (6) from handwheel shaft. Remove eight screws (7) from flange assembly and separate front cover (8) from flange (9). Use care not to damage or distort dial glass gaskets (10) during cover and flange separation.

c. Mask dial glass and flange assembly for protection during remainder of indicator overhaul.

d. Remove four screws (11) from electrical assembly mounting plate. The electrical assembly (12) is now free of the mechanical assembly (13) except for the interconnecting wire harness.

NOTE

The Manual Ordered Bearing Indicator - Command Control, and Manual Ordered Elevation Indicator - Command Control do not contain electrical assemblies. Disregard step (d) when disassembling these indicators.

e. Remove (unscrew) four posts (14) from mechanical assembly. Tag post, for identification during reassembly, that seats gear (15) to front flange. Carefully separate dial glass and flange assembly from the mechanical assembly.

NOTE

To disassemble the dial glass and flange assembly from the Manual Ordered Bearing Indicator - Command Control and Manual Ordered Elevation - Command Control, remove three screws (16) and special screw (17).

3-10.1 Indicator Light Ring and Lamp Disassembly.

NOTE

If indicator light ring and/or lamps do not require replacement, disregard this paragraph and proceed to paragraph 3-10.2.

a. Remove four screws (1, Figure 5-18) from indicator light ring (2). Carefully lift off light ring from dial posts (3).

CAUTION

The indicator light ring is fragile. The four printed circuit lamp boards (4) should separate easily from the light ring. Use care when separating the boards from the light ring and when reassembling the light ring to the indicator assembly. Do not overtighten the four screws (1) as the ring may crack with too much pressure.

3-10.2 Pointer, Dial, and Gear Train Disassembly.

NOTE

If the indicator gear train does not require disassembly and if the pointer and/or dial do not require replacement disregard this paragraph and proceed to paragraph 3-10.3.

- a. Loosen clamp (5) and carefully remove indicator pointer (6) from indicator shaft.
  - b. Remove three screws (7) and carefully remove dial (8) from dial plate.
  - c. Remove three screws (9) and carefully remove dial plate (10) from mechanical assembly.
  - d. Remove three screws (11) and carefully remove front gear plate from mechanical assembly.
- DO NOT REMOVE GEAR ASSEMBLIES FROM REAR PLATE UNTIL TAGGED WITH POSITION NUMBERS GIVEN IN FIGURE 5-19 FOR IDENTIFICATION DURING REASSEMBLY.

3-10.3 Electronic Assembly. The electronic assembly, see Figure 5-20, contains all the electrical and electronic components and assemblies of the indicator except for the synchros and servomotors. The Manual Ordered Bearing Indicator - Command Control and Manual Ordered Elevation Indicator - Command Control do not contain an electronic assembly package. Schematic diagrams for each control-type indicator are given in Figures 5-21 through 5-23. Refer to paragraph 3-8.4 for power supply service instructions and to paragraph 3-8.5 for amplifier service instructions.

3-10.4 Inspection, Cleaning, and Lubrication. Refer to paragraph 3-9, cleaning and lubrication instructions.

3-10.5 Lamp Replacement. Refer to paragraph 3-10 for lamp replacement instructions.

3-10.6 Indicator Reassembly. Indicator reassembly is essentially the reverse of disassembly.

#### NOTE

Do not overtighten screws when reassembling components. Overtightened hardware may be damaged in removal during indicator disassembly.

3-10.7 Indicator Alignment.

- a. Connect indicator to Indicator Test Set connector J2, see Figure 5-1.
- b. Set selector switch "B" to position "OFF", clutch switch to "MANUAL", null selector to "0°", and transmitter selector to "CDX". Apply operating power to the Indicator Test Set.
- c. Adjust indicator handwheel for the smallest null as observed on the oscilloscope. The null shall not exceed 250 millivolts.
- d. Set transmitter selector to "TX".
- e. Loosen synchro control torque transmitter B1 clamps and rotate transmitter housing for the smallest null as observed on the oscilloscope. The null shall not exceed 250 millivolts. Carefully retighten synchro clamps.
- f. Install indicator pointer on indicator shaft at the "0" degree dial position.

3-10.8 Indicator Test. Test the indicator for operation and scale error as outlined under Performance Tests, paragraph 3-6, in this section.





## SECTION IV

## PARTS LIST

## 4-1. General.

This section lists all assemblies, subassemblies and replaceable parts of the antenna position indicators. The lists are in tabular form providing schematic reference symbol, description, part number, and production list data of each entry. The production list data number is a complex number consisting of the production list (List of Material) number, the production list revision letter, and the production list item number for the particular part list.

A separate list is provided for each antenna position indicator and for each subassembly common to all indicators. Table 4-1 is a Table of Contents of the parts list.

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A Vendor List is provided at the end of this section identifying vendors to their Federal Manufacturer's Code as assigned in the Federal Cataloging Handbook - H4-1. Federal Manufacturer's Codes are listed in parentheses in the description column to those parts which are not of Superior manufacture or government standards.

ANTENNA POSITION INDICATORS

ANTENNA BEARING INDICATOR  
730-900-1

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	COVER	730-134-3	730-900-1/E/10
	FRONT COVER	730-56-1	730-900-1/E/3
	FLANGE	730-55-2	730-900-1/E/1
	GASKET, Dial Glass	730-125	730-900-1/E/5
	GLASS, Dial	730-124	730-900-1/E/4
	GASKET, Flange	730-126	730-900-1/E/6
	CONNECTOR	MS3102A-24-28P	730-900-1/E/13
	GASKET, Connector Mounting Plate	730-155	730-900-1/E/21
	INTERNAL ASSEMBLY	730-902-7	730-900-1/E/7
	LIGHT RING	730-53	730-902-7/K/48
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-7/K/45
	POINTER ASSEMBLY (ORDERED)	730-189	730-902-7/K/29
	POINTER ASSEMBLY (ANTENNA)	730-193-1	730-902-7/K/28
	DIAL CARD, Ship's Heading	730-184-1	730-902-7/K/27
	DIAL	730-51-3	730-902-7/K/26
	DIAL PLATE	730-194-1	730-902-7/K/25
B1	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-7/K/2
B2	SERVOMOTOR (same as for B1)	15SM419	730-902-7/K/2
B3	SERVOMOTOR (same as for B1)	15SM419	730-902-7/K/2
B4	SERVOMOTOR (same as for B1)	15SM419	730-902-7/K/2
B5	TRANSFORMER, Synchro Control	15CT6b	730-902-7/K/5
B6	TRANSFORMER, Synchro Control	15CT6b	730-902-7/K/5
B7	TRANSMITTER, Differential, Synchro Control	15CDX6b	730-902-7/K/6



## ANTENNA POSITION INDICATORS

ANTENNA BEARING INDICATOR - Cont'd.  
730-900-1

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
B8	TRANSFORMER, Synchro Control	15CT6b	730-902-7/K/5
B9	TRANSMITTER, Differential, Synchro Control	15CDX6b	730-902-7/K/6
B10	TRANSFORMER, Synchro Control	15CT6b	730-902-7/K/5
	SHAFT AND GEAR ASSEMBLY	730-157	730-902-7/K/9
	SHAFT AND GEAR ASSEMBLY	730-160	730-902-7/K/10
	SHAFT AND GEAR ASSEMBLY	730-162-2	730-902-7/K/11
	SHAFT AND GEAR ASSEMBLY	730-162-1	730-902-7/K/32
	SPUR GEAR	730-230	730-902-7/K/36
	ANTI-BACKLASH GEAR (23266)	ABC-65-120	730-902-7/K/12
	ANTI-BACKLASH GEAR AND HUB ASSEMBLY	730-210	730-902-7/K/49
	GEAR AND SHAFT	730-195	730-902-7/K/43
	ANTI-BACKLASH GEAR AND PINION ASSEMBLY	730-196	730-902-7/K/41
	SHAFT AND ANTI-BACKLASH GEAR ASSEMBLY	730-179-1	730-902-7/K/31
	POINTER SHAFT AND ANTI- BACKLASH GEAR ASSEMBLY	730-174-1	730-902-7/K/30
	ANTI-BACKLASH GEAR CARD DRIVE	730-183	730-902-7/K/38
	ANTI-BACKLASH GEAR AND PINION ASSEMBLY	730-198	730-902-7/K/40
	ELECTRICAL ASSEMBLY	730-901-1	730-900-1/E/9
A1	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-1/F/7
A2	SERVO AMPLIFIER, Same as A1	900-900	730-901-1/F/7
A3	SERVO AMPLIFIER, Same as A1	900-900	730-901-1/F/7

# ANTENNA POSITION INDICATORS

## ANTENNA BEARING INDICATOR - Cont'd. 730-900-1

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
A4	SERVO AMPLIFIER, Same as A1	900-900	730-901-1/F/7
C1	CAPACITOR, electrolytic, 7.5 MFD, 200 VDC (56289)	156P-7.5-200	730-901-1/F/15
C2	CAPACITOR, Same as C1	156P-7.5-200	730-901-1/F/15
C3	CAPACITOR, Same as C1	156P-7.5-200	730-901-1/F/15
C4	CAPACITOR, Same as C1	156P-7.5-200	730-901-1/F/15
PS1	POWER SUPPLY (See page 4-25 for breakdown)	730-910-2	730-901-1/F/2
R1	RESISTOR, fixed, composition, 220K, 1/4W, 5%	RC07GF224J	730-901-1/F/25
R2	RESISTOR, Same as R1	RC07GF224J	730-901-1/F/25
R3	RESISTOR, Same as R1	RC07GF224J	730-901-1/F/25
R4	RESISTOR, Same as R1	RC07GF224J	730-901-1/F/25
R5	RESISTOR, fixed, composition, 10K, 1/4W, 5%	RC07GF103J	730-901-1/F/26
R6	RESISTOR, Same as R5	RC07GF103J	730-901-1/F/26
R7	RESISTOR, Same as R5	RC07GF103J	730-901-1/F/26
R8	RESISTOR, Same as R5	RC07GF103J	730-901-1/F/26
T1	TRANSFORMER (10581)	9085	730-901-1/F/10

## ANTENNA ELEVATION INDICATOR 730-900-2

	COVER	730-134-3	730-900-2/C/10
	FRONT COVER	730-56-1	730-900-2/C/3
	FLANGE	730-55-2	730-900-2/C/1
	GASKET, Dial Glass	730-125	730-900-2/C/5

## ANTENNA POSITION INDICATORS

ANTENNA ELEVATION INDICATOR - Cont'd.  
730-900-2

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	GLASS, Dial	730-124	730-900-2/C/4
	GASKET, Flange	730-126	730-900-2/C/6
	CONNECTOR	MS3102A-24-28P	730-900-2/C/13
	GASKET, Connector Mounting Plate	730-155	730-900-2/C/14
	INTERNAL ASSEMBLY	730-902-8	730-900-2/C/8
	LIGHT RING	730-53	730-902-8/H/48
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-8/H/45
	POINTER ASSEMBLY (ORDERED)	730-189	730-902-8/H/29
	POINTER ASSEMBLY (ANTENNA)	730-193-1	730-902-8/H/28
	DIAL	730-50-2	730-902-8/H/26
	DIAL PLATE	730-194-2	730-902-8/H/25
	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-8/H/2
B3	SERVOMOTOR, Same as B2	15SM419	730-902-8/H/2
B4	SERVOMOTOR, Same as B2	15SM419	730-902-8/H/2
B6	TRANSFORMER, Synchro Control	15CT6b	730-902-8/H/5
B7	TRANSMITTER, Differential, Synchro Control	15CDX6b	730-902-8/H/6
B8	TRANSFORMER, Synchro Control	15CT6b	730-902-8/H/5
B9	TRANSMITTER, Differential, Synchro Control	15CDX6b	730-902-8/H/6
B10	TRANSFORMER, Synchro Control	15CT6b	730-902-8/H/5
	SHAFT AND GEAR ASSEMBLY	730-157	730-902-8/H/9
	SHAFT AND GEAR ASSEMBLY	730-160	730-902-8/H/10
	SHAFT AND GEAR ASSEMBLY	730-162-2	730-902-8/H/11



# ANTENNA POSITION INDICATORS

## ANTENNA ELEVATION INDICATOR - Cont'd. 730-900-2

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	ANTI-BACKLASH GEAR (23266)	ABC-65-120	730-902-8/H/12
	ANTI-BACKLASH GEAR AND HUB ASSEMBLY	730-210	730-902-8/H/49
	GEAR AND SHAFT	730-195	730-902-8/H/43
	ANTI-BACKLASH GEAR AND PINION ASSEMBLY	730-196	730-902-8/H/41
	SHAFT AND ANTI-BACKLASH GEAR ASSEMBLY	730-179-2	730-902-8/H/31
	POINTER SHAFT AND ANTI- BACKLASH GEAR ASSEMBLY	730-174-2	730-902-8/H/30
	ANTI-BACKLASH GEAR AND PINION ASSEMBLY	730-198	730-902-8/H/40
	ELECTRICAL ASSEMBLY	730-901-2	730-900-2/C/9
A2	SERVO AMPLIFIER, (See page 4-24 for breakdown)	900-900	730-901-2/E/7
A3	SERVO AMPLIFIER, Same as A2	900-900	730-901-2/E/7
A4	SERVO AMPLIFIER, Same as A2	900-900	730-901-2/E/7
C2	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC (56289)	156P-7.5-200	730-901-2/E/15
C3	CAPACITOR, Same as C2	156P-7.5-200	730-901-2/E/15
C4	CAPACITOR, Same as C2	156P-7.5-200	730-901-2/E/15
PS1	POWER SUPPLY (See page 4-25 for breakdown)	730-910-2	730-901-2/E/2
R2	RESISTOR, fixed, composition, 220K, 1/4W, 5%	RC07GF224J	730-901-2/E/26
R3	RESISTOR, Same as R2	RC07GF224J	730-901-2/E/26
R4	RESISTOR, Same as R2	RC07GF224J	730-901-2/E/26
R6	RESISTOR, fixed, composition, 10K, 1/4W, 5%	RC07GF103J	730-901-2/E/25

## ANTENNA POSITION INDICATORS

ANTENNA ELEVATION INDICATOR - Cont'd.  
730-900-2

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
R7	RESISTOR, Same as R6	RC07GF103J	730-901-2/E/25
R8	RESISTOR, Same as R6	RC09GF103J	730-901-2/E/25
T1	TRANSFORMER (10581)	9085	730-901-2/E/10

ACQUISITION BEARING INDICATOR  
730-900-7

	COVER	730-134-3	730-900-7/D/10
	FRONT COVER	730-56-1	730-900-7/D/3
	FLANGE	730-55-2	730-900-7/D/1
	GASKET, Dial Glass	730-125	730-900-7/D/5
	GLASS, Dial	730-124	730-900-7/D/4
	GASKET, Flange	730-126	730-900-7/D/6
	CONNECTOR	MS3102A-24-28P	730-900-7/D/13
	GASKET, Connector Mount Plate	730-155	730-900-7/D/21
	INTERNAL ASSEMBLY	730-902	730-900-7/D/7
	LIGHT RING	730-53	730-902-9/M/48
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-9/M/45
	POINTER ASSEMBLY (ANTENNA)	730-193-2	730-902-9/M/28
	DIAL CARD, Ship's Heading	730-184-1	730-902-9/M/27
	DIAL	730-51-3	730-902-9/M/26
	DIAL PLATE	730-194-1	730-902-9/M/25
B1	SERVOMOTOR, Size 15, 400 CPS (14404)	15SM419	730-902-9/M/2
B2	SERVOMOTOR, Same as B1	15SM419	730-902-9/M/2

ANTENNA POSITION INDICATORS

ACQUISITION BEARING INDICATOR - Cont'd.  
730-900-7

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
B3	SERVOMOTOR, Same as B1	15SM419	730-902-9/M/2
B5	TRANSFORMER, Synchro Control	15CT6b	730-902-9/M/5
B6	TRANSFORMER, Synchro Control	15CT6b	730-902-9/M/5
B7	TRANSMITTER, Differential, Synchro Control	15CDX6b	730-902-9/M/6
B8	TRANSFORMER, Synchro Control	15CT6b	730-902-9/M/5
	SHAFT AND GEAR ASSEMBLY	730-157	730-902-9/M/9
	SHAFT AND GEAR ASSEMBLY	730-160	730-902-9/M/10
	SHAFT AND GEAR ASSEMBLY	730-162-2	730-902-9/M/11
	SHAFT AND GEAR ASSEMBLY	730-162-1	730-902-9/M/32
	SPUR GEAR	730-230	730-902-9/M/36
	ANTI-BACKLASH GEAR (23266)	ABC-65-120	730-902-9/M/12
	POINTER SHAFT AND ANTI- BACKLASH GEAR ASSEMBLY	730-182-1	730-902-9/M/29
	ANTI-BACKLASH GEAR CARD DRIVE	730-183	730-902-9/M/38
	ANTI-BACKLASH GEAR AND PINION ASSEMBLY	730-198	730-902-9/M/41
	ELECTRICAL ASSEMBLY	730-901-2	730-900-7/D/9
A2	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-2/E/7
A3	SERVO AMPLIFIER, Same as A2	900-900	730-901-2/E/7
A4	SERVO AMPLIFIER, Same as A2	900-900	730-901-2/E/7
C2	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC (56289)	156P-7.5-200	730-901-2/E/15
C3	CAPACITOR, Same as C2	156P-7.5-200	730-901-2/E/15
C4	CAPACITOR, Same as C2	156P-7.5-200	730-901-2/E/15



## ANTENNA POSITION INDICATORS

ACQUISITION BEARING INDICATOR - Cont'd.  
730-900-7

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
PS1	POWER SUPPLY (See page 4-25 for breakdown)	730-910-2	730-901-2/E/2
R2	RESISTOR, fixed, composition, 220K, 1/4W, 5%	RC07GF224J	730-901-2/E/26
R3	RESISTOR, Same as R2	RC07GF224J	730-901-2/E/26
R4	RESISTOR, Same as R2	RC07GF224J	730-901-2/E/26
R6	RESISTOR, fixed, composition, 10K, 1/4W, 5%	RC07GF103J	730-901-2/E/25
R7	RESISTOR, Same as R6	RC07GF103J	730-901-2/E/25
R8	RESISTOR, Same as R6	RC07GF103J	730-901-2/E/25
T1	TRANSFORMER (10581)	9085	730-901-2/E/10

ACQUISITION ELEVATION INDICATOR  
730-900-8

	COVER	730-134-3	730-900-8/B/10
	FRONT COVER	730-56-1	730-900-8/B/3
	FLANGE	730-55-2	730-900-8/B/1
	GASKET, Dial Glass	730-125	730-900-8/B/5
	GLASS, Dial	730-124	730-900-8/B/4
	GASKET, Flange	730-126	730-900-8/B/6
	CONNECTOR	MS3102A-24-28 P	730-900-8/B/13
	GASKET, Connector Mounting Plate	730-155	730-900-8/B/21
	INTERNAL ASSEMBLY	730-902-10	730-900-8/B/7
	LIGHT RING	730-53	730-902-10/H/48
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-10/H/45

ANTENNA POSITION INDICATORS

ACQUISITION ELEVATION INDICATOR - Cont'd.  
730-900-8

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REF/ ITEM NO.
	POINTER ASSEMBLY (ANTENNA)	730-915	730-902-10/H/26
	DIAL	730-50-2	730-902-10/H/25
	DIAL PLATE	730-194-2	730-902-10/H/24
B2	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-10/H/2
B3	SERVOMOTOR, Same as B2	15SM419	730-902-10/H/2
B6	TRANSFORMER, Synchro Control	15CT6b	730-902-10/H/5
B7	TRANSMITTER, Differential, Synchro Control	15CDX6b	730-902-10/H/6
B8	TRANSFORMER, Synchro Control	15CT6b	730-902-10/H/5
	SHAFT AND GEAR ASSEMBLY	730-157	730-902-10/H/9
	SHAFT AND GEAR ASSEMBLY	730-160	730-902-10/H/10
	SHAFT AND GEAR ASSEMBLY	730-162-2	730-902-10/H/11
	ANTI-BACKLASH GEAR (23266)	ABC-65-120	730-902-10/H/12
	POINTER SHAFT AND ANTI- BACKLASH GEAR ASSEMBLY	730-182-2	730-902-10/H/28
	ANTI-BACKLASH GEAR AND PINION ASSEMBLY	730-198	730-902-10/H/30
	ELECTRICAL ASSEMBLY	730-901-4	730-900-8/B/9
A2	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-4/C/7
A3	SERVO AMPLIFIER, Same as A2	900-900	730-901-4/C/7
C2	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC (56289)	156P-7.5-200	730-901-4/C/15
C3	CAPACITOR, Same as C2	156P-7.5-200	730-901-4/C/15
PS1	POWER SUPPLY (See page 4-26 for breakdown)	730-910-3	730-901-4/C/2

## ANTENNA POSITION INDICATORS

ACQUISITION ELEVATION INDICATOR - Cont'd.  
730-900-8

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
R2	RESISTOR, fixed, composition, 220K, 1/4W, 5%	RC07GF224J	730-901-4/C/25
R3	RESISTOR, Same as R2	RC07GF224J	730-901-4/C/25
R4	RESISTOR, fixed, composition, 10K, 1/4W, 5%	RC07GF103J	730-901-4/C/26
R5	RESISTOR, Same as R4	RC07GF103J	730-901-4/C/26
T1	TRANSFORMER (10581)	9085	730-901-4/C/10

SHIP'S HEADING INDICATOR  
730-900-9

	COVER	730-134-3	730-900-9/A/10
	FRONT COVER	730-56-1	730-900-9/A/3
	FLANGE	730-55-2	730-900-9/A/1
	GASKET, Dial Glass	730-125	730-900-9/A/5
	GLASS, Dial	730-124	730-900-9/A/4
	GASKET, Flange	730-126	730-900-9/A/6
	CONNECTOR	MS3102A-24-28P	730-900-9/A/13
	GASKET, Connector Mounting Plate	730-155	730-900-9/A/16
	INTERNAL ASSEMBLY	730-902-11	730-900-9/A/7
	LIGHT RING	730-53	730-902-1/K/48
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-1/K/45
	DIAL CARD, Ship's Heading	730-184-2	730-902-11/K/24
	DIAL	730-51-1	730-902-11/K/23
	DIAL PLATE	730-194-1	730-902-11/K/22
B1	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-11/K/2



ANTENNA POSITION INDICATORS

SHIP'S HEADING INDICATOR - Cont'd.  
730-900-9

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
B5	TRANSFORMER, Synchro Control	15CT6b	730-902-11/K/5
	SHAFT AND GEAR ASSEMBLY	730-157	730-902-11/K/8
	SHAFT AND GEAR ASSEMBLY	730-160	730-902-11/K/9
	SHAFT AND GEAR ASSEMBLY	730-162-1	730-902-11/K/10
	SPUR GEAR	730-230	730-902-11/K/28
	ANTI-BACKLASH GEAR (23266)	ABC-65-120	730-902-11/K/11
	ANTI-BACKLASH GEAR CARD DRIVE	730-183	730-902-11/K/30
	ELECTRICAL ASSEMBLY	730-901-3	730-900-9/-/9
A1	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-3/C/7
C1	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC (56289)	156P-7.5-200	730-901-3/C/15
PS1	POWER SUPPLY (See page 4-26 for breakdown)	730-910-3	730-901-3/C/2
T1	TRANSFORMER (10581)	9085	730-901-3/C/10

BEARING LIMIT INDICATOR  
730-900-5

	FRONT COVER	730-1	730-900-5/C/1
	GLASS, Dial	730-4	730-900-5/C/4
	GASKET, Dial Glass	730-2	730-900-5/C/2
	GASKET, Flange	730-3	730-900-5/C/3
	FLANGE	730-5	730-900-5/C/5
	LIGHT RING	730-31	730-900-5/C/31
	MARKER, Fiducial	730-35	730-900-5/C/35

## ANTENNA POSITION INDICATORS

BEARING LIMIT INDICATOR - Cont'd.  
730-900-5

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
B1	POINTER	730-25-1	730-900-5/C/25
	DIAL	730-20	730-900-5/C/20
	RECEIVER, Synchro Torque	23TR6a	730-900-5/C/9
	PRINTED CIRCUIT LAMP BOARD	730-33	730-900-5/C/33
ELEVATION LIMIT INDICATOR 730-900-6			
B1	FRONT COVER	730-1	730-900-6/A/1
	GLASS, Dial	730-4	730-900-6/A/4
	GASKET, Dial Glass	730-2	730-900-6/A/2
	GASKET, Flange	730-3	730-900-6/A/3
	FLANGE	730-5	730-900-6/A/5
	LIGHT RING	730-31	730-900-6/A/21
	POINTER	730-25-1	730-900-6/A/17
	DIAL	730-14-1	730-900-6/A/14
	RECEIVER, Synchro Torque	23TR6a	730-900-6/A/9
	PRINTED CIRCUIT LAMP BOARD	730-33	730-900-6/A/23
BEARING LIMIT COMMAND CONTROL INDICATOR 730-900-10			
	FRONT COVER	730-1	730-900-10/A/1
	GLASS, Dial	730-4	730-900-10/A/4
	GASKET, Dial Glass	730-2	730-900-10/A/2
	GASKET, Flange	730-3	730-900-10/A/3

# ANTENNA POSITION INDICATORS

## BEARING LIMIT COMMAND CONTROL INDICATOR - Cont'd. 730-900-10

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
B1	FLANGE	730-5	730-900-10/A/5
	LIGHT RING	730-31	730-900-10/A/21
	POINTER	730-25-1	730-900-10/A/17
	DIAL	730-44	730-900-10/A/1
	RECEIVER, Synchro Torque	23TR6a	730-900-10/A/9
	PRINTED CIRCUIT LAMP BOARD	730-33	730-900-10/A/23

## ELEVATION LIMIT - COMMAND CONTROL INDICATOR 730-900-11

B1	FRONT COVER	730-1	730-900-11/A/1
	GLASS, Dial	730-4	730-900-11/A/4
	GASKET, Dial Glass	730-2	730-900-11/A/2
	GASKET, Flange	730-3	730-900-11/A/3
	FLANGE	730-5	730-900-11/A/5
	LIGHT RING	730-31	730-900-11/A/21
	POINTER	730-25-1	730-900-11/A/17
	DIAL	730-14-2	730-900-11/A/14
	RECEIVER, Synchro Torque	23TR6a	730-900-11/A/9
	PRINTED CIRCUIT LAMP BOARD	730-33	730-900-21/A/23

## MANUAL ORDERED BEARING INDICATOR 730-900-3

	COVER	730-134-1	730-900-3/C/10
	FRONT COVER	730-56-2	730-900-3/C/3



## ANTENNA POSITION INDICATORS

MANUAL ORDERED BEARING INDICATOR - Cont'd.  
730-900-3

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	FLANGE	730-55-1	730-900-3/C/1
	GASKET, Dial Glass	730-125	730-900-3/C/5
	GLASS, Dial	730-124	730-900-3/C/4
	GASKET, Flange	730-126	730-900-3/C/6
	CONNECTOR	MS3102A-24-28P	730-900-3/C/13
	GASKET, Connector Mounting Plate	730-155	730-900-3/C/21
	HANDWHEEL CRANK (23266)	HC-P2	730-900-3/C/15
	CRANKSHAFT, Handwheel	730-188	730-900-3/C/24
	INTERNAL ASSEMBLY	730-902-1	730-900-3/C/8
	LIGHT RING	730-53	730-902-1/J/37
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-1/J/36
	POINTER ASSEMBLY	730-915	730-902-1/J/41
	DIAL	730-51-2	730-902-1/J/32
	DIAL PLATE	730-143	730-902-1/J/30
B1	TRANSMITTER, Synchro Torque	23TX6b	730-902-1/J/3
B2	TRANSMITTER, Synchro Control Differential	23CDX6b	730-902-1/J/2
B3	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-1/J/5
B4	CLUTCH, Magnetic (02719)	SC-8-2	730-902-1/J/23
B5	CLUTCH, Magnetic, Same as B4	SC-8-2	730-902-1/J/23
B6	TRANSFORMER, Synchro Control	15CT6b	730-902-1/J/6
	PINION AND GEAR ASSEMBLY	730-113	730-902-1/J/17
	PINION AND GEAR ASSEMBLY	730-111	730-902-1/J/18
	PINION AND GEAR ASSEMBLY	730-115	730-902-1/J/19

ANTENNA POSITION INDICATORS

MANUAL ORDERED BEARING INDICATOR - Cont'd.  
730-900-3

REF SYM	DESCRIPTION	PART NUMBER	PROD/LIST/REV/ ITEM NO.
	PINION AND GEAR ASSEMBLY	730-148	730-902-1/J/21
	POINTER SHAFT AND GEAR ASSEMBLY	730-118	730-902-1/J/20
	SHAFT AND GEAR ASSEMBLY	730-150	730-902-1/J/22
	GEAR CLUTCH	730-116	730-902-1/J/24
	GEAR, Split Hub	730-138	730-902-1/J/25
	ANTI-BACKLASH GEAR (23266)	ABC 65-117	730-902-1/J/7
	ANTI-BACKLASH GEAR (23266)	ABC 69-160	730-902-1/J/4
	GEAR SPUR (23266)	GP56-32	730-902-1/J/13
	ELECTRICAL ASSEMBLY	730-901-3	730-900-3/C/9
A1	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-3/C/7
C1	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC, (56289)	156P-7.5-200	730-901-3/C/15
PS1	POWER SUPPLY (See page 4-26 for breakdown)	730-910-3	730-901-3/C/2
T1	TRANSFORMER (10581)	9085	730-901-3/C/10

MANUAL ORDERED ELEVATION INDICATOR  
730-900-4

	COVER	730-134-1	730-900-4/C/10
	FRONT COVER	730-56-2	730-900-4/C/3
	FLANGE	730-55-1	730-900-4/C/1
	GASKET, Dial Glass	730-125	730-900-4/C/5
	GLASS, Dial	730-126	730-900-4/C/4
	GASKET, Flange	730-126	730-900-4/C/6

## ANTENNA POSITION INDICATORS

MANUAL ORDERED ELEVATION INDICATOR - Cont'd.  
730-900-4

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	CONNECTOR	MS3102A-24-28P	730-900-4/C/13
	GASKET, Connector Mounting Plate	730-155	730-900-4/C/21
	HANDWHEEL CRANK (23266)	HC-P2	730-900-4/C/15
	CRANKSHAFT, Handwheel	730-188	730-900-4/C/24
	INTERNAL ASSEMBLY	730-902-2	730-900-4/C/8
	LIGHT RING	730-53	730-902-2/K/37
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-2/K/36
	POINTER ASSEMBLY	730-915	730-902-2/K/41
	DIAL	730-50-1	730-902-2/K/32
	DIAL PLATE	730-143	730-902-2/K/30
B1	TRANSMITTER, Synchro Torque	23TX6b	730-902-2/K/3
B2	TRANSMITTER, Synchro Control Differential	23CDX6b	730-902-2/K/2
B3	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-2/K/5
B4	CLUTCH, Magnetic (02719)	SC-8-2	730-902-2/K/23
B5	CLUTCH, Magnetic, Same as B4	SC-8-2	730-902-2/K/23
B6	TRANSFORMER, Synchro Control	15CT6b	730-902-2/K/6
	PINION AND GEAR ASSEMBLY	730-113	730-902-2/K/17
	PINION AND GEAR ASSEMBLY	730-111	730-902-2/K/18
	PINION AND GEAR ASSEMBLY	730-115	730-902-2/K/19
	POINTER SHAFT AND GEAR ASSEMBLY	730-118	730-902-2/K/20
	PINION AND GEAR ASSEMBLY	730-148	730-902-2/K/21
	SHAFT AND GEAR ASSEMBLY	730-150	730-902-2/K/22



# ANTENNA POSITION INDICATORS

## MANUAL ORDERED ELEVATION INDICATOR - Cont'd. 730-900-4

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	GEAR CLUTCH	730-116	730-902-2/K/24
	GEAR, Split Hub	730-138	730-902-2/K/25
	ANTI-BACKLASH GEAR (23266)	ABC 65-117	730-902-2/K/7
	ANTI-BACKLASH GEAR (23266)	ABC 69-160	730-902-2/K/4
	GEAR SPUR (23266)	GP56-32	730-902-2/K/13
	ELECTRICAL ASSEMBLY	730-901-3	730-900-4/C/9
A1	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-3/C/7
C1	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC, (56289)	156P-7.5-200	730-901-3/C/15
PS1	POWER SUPPLY (See page 4-26 for breakdown)	730-910-3	730-901-3/C/2
T1	TRANSFORMER (10581)	9085	730-901-3/C/10

## MANUAL ORDERED BEARING - TM2 INDICATOR 730-900-12

	COVER	730-134-1	730-900-12/C/10
	FRONT COVER	730-56-2	730-900-12/C/3
	FLANGE	730-55-1	730-900-12/C/1
	GASKET, Dial Glass	730-125	730-900-12/C/5
	GLASS, Dial	730-124	730-900-12/C/4
	GASKET, Flange	730-126	730-900-12/C/6
	CONNECTOR	MS3102A-24-28P	730-900-12/C/13
	GASKET, Connector Mounting Plate	730-155	730-900-12/C/21
	HANDWHEEL CRANK (23266)	HC-P2	730-900-12/C/15

## ANTENNA POSITION INDICATORS

MANUAL ORDERED BEARING - TM2 INDICATOR - Cont'd.  
730-900-12

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	CRANKSHAFT, Handwheel	730-188	730-900-12/C/24
	INTERNAL ASSEMBLY	730-902-3	730-900-12/C/8
	LIGHT RING	730-53	730-902-3/H/37
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-3/H/36
	POINTER ASSEMBLY	730-915	730-902-3/H/41
	DIAL	730-51-2	730-902-3/H/32
	DIAL PLATE	730-143	730-902-3/H/30
B1	TRANSMITTER, Synchro Torque	23TX6b	730-902-3/H/3
B2	TRANSMITTER, Synchro Control Differential	23CDX6b	730-902-3/H/2
B3	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-3/H/5
B4	CLUTCH, Magnetic (02719)	SC-8-2	730-902-3/H/23
B5	CLUTCH, Magnetic, Same as B4	SC-8-2	730-902-3/H/23
	PINION AND GEAR ASSEMBLY	730-113	730-902-3/H/17
	PINION AND GEAR ASSEMBLY	730-111	730-902-3/H/18
	PINION AND GEAR ASSEMBLY	730-115	730-902-3/H/19
	POINTER SHAFT AND GEAR ASSEMBLY	730-118	730-902-3/H/20
	SHAFT AND GEAR ASSEMBLY	730-150	730-902-3/H/7
	PINION AND GEAR ASSEMBLY	730-148	730-902-3/H/6
	GEAR CLUTCH	730-116	730-902-3/H/24
	GEAR, Split Hub	730-138	730-902-3/H/25
	ANTI-BACKLASH GEAR (23266)	ABC 69-160	730-902-3/H/4
	GEAR SPUR (23266)	GP56-32	730-902-3/H/11

# ANTENNA POSITION INDICATORS

## MANUAL ORDERED BEARING - TM2 INDICATOR - Cont'd. 730-900-12

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	ELECTRICAL ASSEMBLY	730-901-3	730-900-12/C/9
A1	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-3/C/7
C1	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC, (56289)	156P-7.5-200	730-901-3/C/15
PS1	POWER SUPPLY (See page 4-26 for breakdown)	730-910-3	730-901-3/C/2
T1	TRANSFORMER (10581)	9085	730-901-3/C/10

## MANUAL ORDERED ELEVATION - TM2 - INDICATOR 730-900-13

	COVER	730-134-1	730-900-13/C/10
	FRONT COVER	730-56-2	730-900-13/C/3
	FLANGE	730-55-1	730-900-13/C/1
	GASKET, Dial Glass	730-125	730-900-13/C/5
	GLASS, Dial	370-124	730-900-13/C/4
	GASKET, Flange	730-126	730-900-13/C/6
	CONNECTOR	MS102A-24-28P	730-900-13/C/13
	GASKET, Connector Mounting Plate	730-155	730-900-13/C/21
	HANDWHEEL CRANK (23266)	HC-P2	730-900-13/C/15
	CRANKSHAFT, Handwheel	730-188	730-900-13/C/24
	INTERNAL ASSEMBLY	730-902-4	730-900-13/C/8
	LIGHT RING	730-53	730-902-4/H/37
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-4/H/36
	POINTER ASSEMBLY	730-915	730-902-4/H/41



## ANTENNA POSITION INDICATORS

MANUAL ORDERED ELEVATION - TM2 - INDICATOR - Cont'd.  
730-900-13

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	DIAL	730-50-1	730-902-4/H/32
	DIAL PLATE	730-144	730-902-4/H/30
B1	TRANSMITTER, Synchro Torque	23TX6b	730-902-4/H/3
B2	TRANSMITTER, Synchro Control Differential	23CDX6b	730-902-4/H/2
B3	SERVOMOTOR, size 15, 400 CPS (14404)	15SM419	730-902-4/H/5
B4	CLUTCH, Magnetic (02719)	SC-8-2	730-902-4/H/23
B5	CLUTCH, Magnetic, same as B4	SC-8-2	730-902-4/H/23
	PINION AND GEAR ASSEMBLY	730-113	730-902-4/H/17
	PINION AND GEAR ASSEMBLY	730-111	730-902-4/H/18
	PINION AND GEAR ASSEMBLY	730-115	730-902-4/H/19
	POINTER SHAFT AND GEAR ASSEMBLY	730-118	730-902-4/H/20
	SHAFT AND GEAR ASSEMBLY	730-150	730-902-4/H/7
	PINION AND GEAR ASSEMBLY	730-148	730-902-4/H/6
	GEAR CLUTCH	730-116	730-902-4/H/24
	GEAR, Split Hub	730-138	730-902-4/H/25
	GEAR, Spur	GP56-32	730-902-4/H/11
	ANTI-BACKLASH GEAR (23266)	ABC 69-160	730-902-4/H/4
	ELECTRICAL ASSEMBLY	730-901-3	730-900-13/C/9
A1	SERVO AMPLIFIER (See page 4-24 for breakdown)	900-900	730-901-3/C/7
C1	CAPACITOR, electrolytic, 7.5 MFD, 200 WVDC, (56289)	156P-7.5-200	730-901-3/C/15
PS1	POWER SUPPLY	730-910-3	730-901-3/C/2
T1	TRANSFORMER (10581)	9085	730-901-3/C/10

ANTENNA POSITION INDICATORS

MANUAL ORDERED BEARING - COMMAND CONTROL - INDICATOR  
730-900-14

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	COVER	730-139-1	730-900-14/F/10
	FRONT COVER	730-56-2	730-900-14/F/3
	FLANGE	730-55-1	730-900-14/F/1
	GASKET, Dial Glass	730-125	730-900-14/F/5
	GLASS, Dial	730-124	730-900-14/F/4
	GASKET, Flange	730-126	730-900-14/F/6
	CONNECTOR	MS3102A-24-28P	730-900-14/F/13
	GASKET, Connector Mounting Plate	730-155	730-900-14/F/21
	HANDWHEEL CRANK (23266)	HC-P2	730-900-14/F/15
	CRANKSHAFT, Handwheel	730-188	730-900-14/F/24
	INTERNAL ASSEMBLY	730-902-5	730-900-14/F/8
	LIGHT RING	730-53	730-902-5/G/37
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-5/G/36
	POINTER ASSEMBLY	730-915	730-902-5/G/41
	DIAL	730-51-2	730-902-5/G/32
	DIAL PLATE	730-143	730-902-5/G/30
B1	TRANSMITTER, Synchro Torque	23TX6b	730-902-5/G/3
B2	TRANSMITTER, Synchro Control Differential	23CDX6b	730-902-5/G/2
B3	CLUTCH, Magnetic (02719)	SC-8-2	730-902-5/G/23
	PINION AND GEAR ASSEMBLY	730-148	730-902-5/G/6
	POINTER SHAFT AND GEAR ASSEMBLY	730-118	730-902-5/G/20
	SHAFT AND GEAR ASSEMBLY	730-150	730-902-5/G/7
	GEAR CLUTCH	730-116	730-902-5/G/24

## ANTENNA POSITION INDICATORS

MANUAL ORDERED BEARING - COMMAND CONTROL - INDICATOR - Cont'd.  
730-900-14

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
	GEAR, Split Hub	730-138	730-902-5/G/25
	GEAR, Spur (23266)	GP56-32	730-902-5/G/13
	ANTI-BACKLASH GEAR (23266)	ABC 69-160	730-902-5/G/4

MANUAL ORDERED ELEVATION - COMMAND CONTROL - INDICATOR  
730-900-15

	COVER	730-134-1	730-900-15/E/10
	FRONT COVER	730-56-2	730-900-15/E/3
	FLANGE	730-55-1	730-900-15/E/1
	GASKET, Dial Glass	730-125	730-900-15/E/5
	GLASS, Dial	730-124	730-900-15/E/4
	GASKET, Flange	730-126	730-900-15/E/6
	CONNECTOR	MS3102A-24-28P	730-900-15/E/13
	GASKET, Connector Mounting Plate	730-155	730-900-15/E/21
	HANDWHEEL CRANK (23266)	HC-P2	730-900-15/E/15
	CRANKSHAFT, Handwheel	730-188	730-900-15/E/26
	INTERNAL ASSEMBLY	730-902-6	730-900-15/E/8
	LIGHT RING	730-53	730-902-6/H/37
	PRINTED CIRCUIT LAMP BOARD	730-54	730-902-6/H/36
	POINTER ASSEMBLY	730-915	730-902-6/H/41
	DIAL	730-50-1	730-902-6/H/32
	DIAL PLATE	730-143	730-902-6/H/30
B1	TRANSMITTER, Synchro Torque	23TX6b	730-902-6/H/3
B2	TRANSMITTER, Synchro Control Differential	23CDX6b	730-902-6/H/2



ANTENNA POSITION INDICATOR

MANUAL ORDERED ELEVATION - COMMAND CONTROL - INDICATOR - Cont'd.  
730-900-15

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
B3	CLUTCH, Magnetic (02719)	SC-8-2	730-902-6/H/23
	PINION AND GEAR ASSEMBLY	730-148	730-902-6/H/6
	POINTER SHAFT AND GEAR ASSEMBLY	730-118	730-902-6/H/20
	SHAFT AND GEAR ASSEMBLY	730-150	730-902-6/H/7
	GEAR CLUTCH	730-116	730-902-6/H/24
	GEAR, Split Hub	730-138	730-902-6/H/25
	GEAR, Spur (23266)	GP56-32	730-902-6/H/13
	ANTI-BACKLASH GEAR (23266)	ABC 69-160	730-902-6/H/4

SERVO AMPLIFIER  
900-900

*	SERVOAMPLIFIER	900-900	Reference
C1	CAPACITOR, electrolytic, 4.7 MFD, 20 WVDC, (56289)	150D475X0020B2	900-900/C/16
C2	CAPACITOR, electrolytic, 0.15 MFD, 50 WVDC, (12954)(See note below)	5C51	900-900/C/17
C3	CAPACITOR, electrolytic, 15 MFD, 35 WVDC, (56289)	150D156X0035R2	900-900/C/18
C4	CAPACITOR, electrolytic, 0.047 MFD, 50 WVDC	CS138F475K	900-900/C/19
CR1	DIODE	1N914	900-900/C/20
CR2	DIODE, Same as CR1	1N914	900-900/C/20
Q1	TRANSISTOR	2N1501	900-900/C/24
Q2	TRANSISTOR, Same as Q1	2N1501	900-900/C/24
Q3	TRANSISTOR	2N718	900-900/C/23

## ANTENNA POSITION INDICATORS

SERVO AMPLIFIER - Cont'd.  
900-900

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
Q4	TRANSISTOR, Same as Q3	2N718	900-900/C/23
R1	RESISTOR, fixed, composition, 100K, 1/4W, 5%	RC07GF104J	900-900/C/26
R2	RESISTOR, Same as R1	RC07GF104J	900-900/C/26
R3	RESISTOR, fixed, composition, 200 ohms, 1/4W, 5%	RC07GF220J	900-900/C/27
R4	RESISTOR, fixed, composition, 15K, 1/4W, 5%	RC07GF153J	900-900/C/28
R5	RESISTOR, fixed, composition, 10K, 1/4W, 5%	RC07GF103J	900-900/C/29
R6	RESISTOR, fixed, wirewound, 6.8 ohms 1W, (56289)	239E6R85	900-900/C/30
R7	RESISTOR, Same as R6	239E6R85	900-900/C/30
R8	RESISTOR, fixed, composition, 2K, 1/2W, 5%	RC20GF202J	900-900/C/31
T1	TRANSFORMER (72149)	108-001	900-900/C/35
T2	TRANSFORMER, Same as T1	108-001	900-900/C/35
NOTE: Capacitor C2 was a combination of two 0.068 MFD capacitors connected in parallel to effect a total of 0.136 MFD. The capacitor listed above should now be used to replace the parallel combination when defective.			
POWER SUPPLY 730-910-2			
C1	CAPACITOR, electrolytic, 1300 MFD, 75 WVDC (72699)	CQMS-1102	730-910-2/F/9
C2	CAPACITOR, electrolytic, 450 MFD, 75 WVDC (53021)	DCM-539-2553-01	730-910-2/F/8
CR1	DIODE	1N1614	730-910-2/F/15

ANTENNA POSITION INDICATORS

POWER SUPPLY - Cont'd.  
730-910-2

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
CR2	DIODE, Same as CR1	1N1614	730-910-2/F/15
CR3	DIODE, Same as CR1	1N1614	730-910-2/F/15
CR4	DIODE, Same as CR1	1N1614	730-910-2/F/15
CR5	DIODE	1N2069	730-910-2/F/16
CR6	DIODE	1N2988B	730-910-2/F/17
Q1	TRANSISTOR (04713)	2N1545	730-910-2/F/18
Q2	TRANSISTOR, Same as Q1	2N1545	730-910-2/F/18
R1	RESISTOR, fixed, wirewound, 250 ohms, 5W (44655)	1521	730-910-2/F/10
R2	RESISTOR, fixed, composition, 1 ohm, 1W, 5%	RC32GF010J	730-910-2/F/11
R3	RESISTOR, Same as R2	RC32GF010J	730-910-2/F/12
R4	RESISTOR, fixed, composition, 2.7K, 1W, 5%	RC32GF273J	730-910-2/F/14
<p>POWER SUPPLY 730-910-3</p>			
C1	CAPACITOR, electrolytic, 1300 MFD, 75 WVDC, (72699)	CQMS-1102	730-910-3/B/9
C2	CAPACITOR, electrolytic, 450 MFD, 75 WVDC, (53021)	DCM-539-2553-01	730-910-3/B/8
CR1	DIODE	1N1614	730-910-3/B/15
CR2	DIODE, Same as CR1	1N1614	730-910-3/B/15
CR3	DIODE, Same as CR1	1N1614	730-910-3/B/15
CR4	DIODE, Same as CR1	1N1614	730-910-3/B/15
CR5	DIODE (93332)	1N2069	730-910-3/B/16



# ANTENNA POSITION INDICATORS

POWER SUPPLY - Cont'd.  
730-910-3

REF SYM	DESCRIPTION	PART NUMBER	PROD LIST/REV/ ITEM NO.
CR6	DIODE	1N2988	730-910-3/B/17
Q1	TRANSISTOR (04713)	2N1545	730-910-3/B/18
R1	RESISTOR, fixed, wirewound, 250 ohms, 5W (44655)	1521	730-910-3/B/10
R2	RESISTOR, fixed, composition, 1 ohm, 1W, 5%	RC32GF010J	730-910-3/B/11
R5	RESISTOR, Same as R2	RC32GF010J	730-910-3/B/14

TABLE 4-2. LIST OF VENDORS

CODE	VENDOR/ADDRESS
02719	American Precision Industries, Buffalo, N. Y.
04713	Motorola Semiconductor Products, Phoenix, Ariz.
10581	Magnetico, East Northport, N. Y.
10651	Vernitron Corp., Farmingdale, N. Y.
12954	Dickson Electronics, Scottsdale, Ariz.
14404	Tachtronic Instrument, New Ulm, Minn.
23266	Superior Electromechanic Component Service, Long Island City, N. Y.
44655	Ohmite Manufacturing Co., Skokie, Ill.
53021	Sangamo Electric Co., Springfield, Ill.
56289	Sprague Electric Co., North Adams, Mass.
72149	Electronic Transformer Corp., Passaic, N. J.
72699	General Instrument Corp., Newark, N. J.
93332	Sylvania Electric Products, Woburn, Mass.



SECTION V  
SCHEMATIC DIAGRAMS





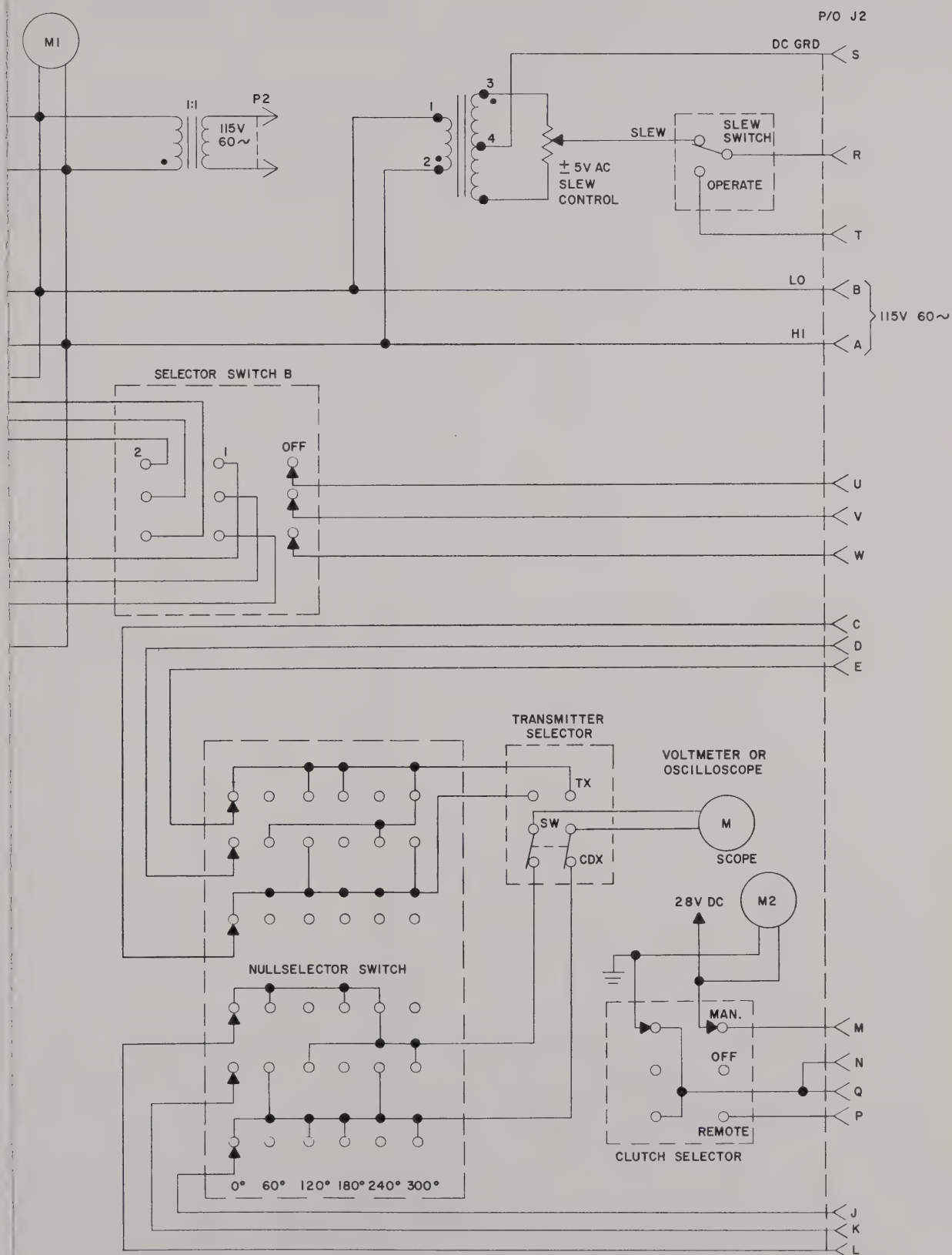


Figure 5-1. Indicator Test Set





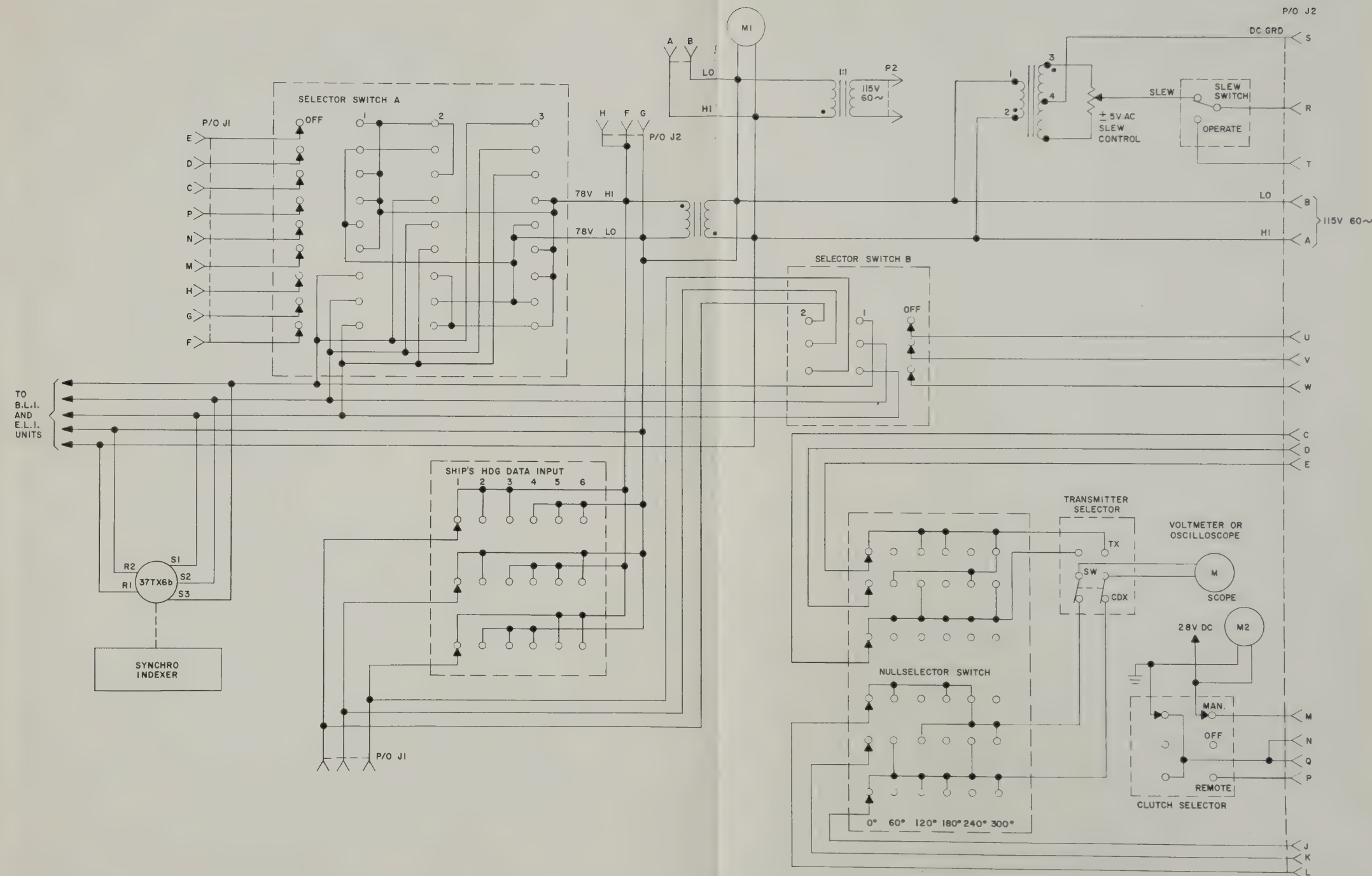


Figure 5-1. Indicator Test Set



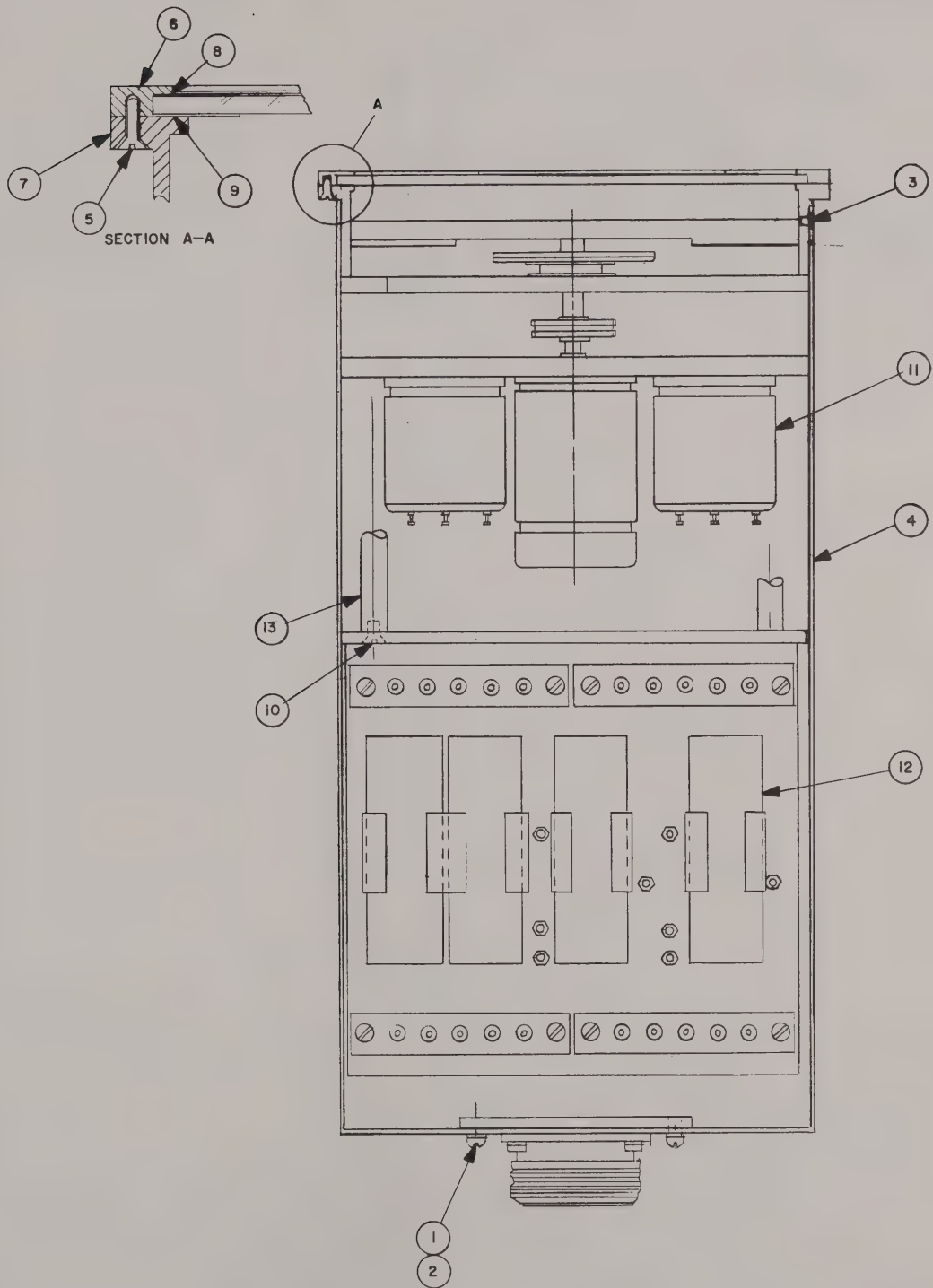


Figure 5-2. Primary-Type Indicator,  
Cross-Sectional Views





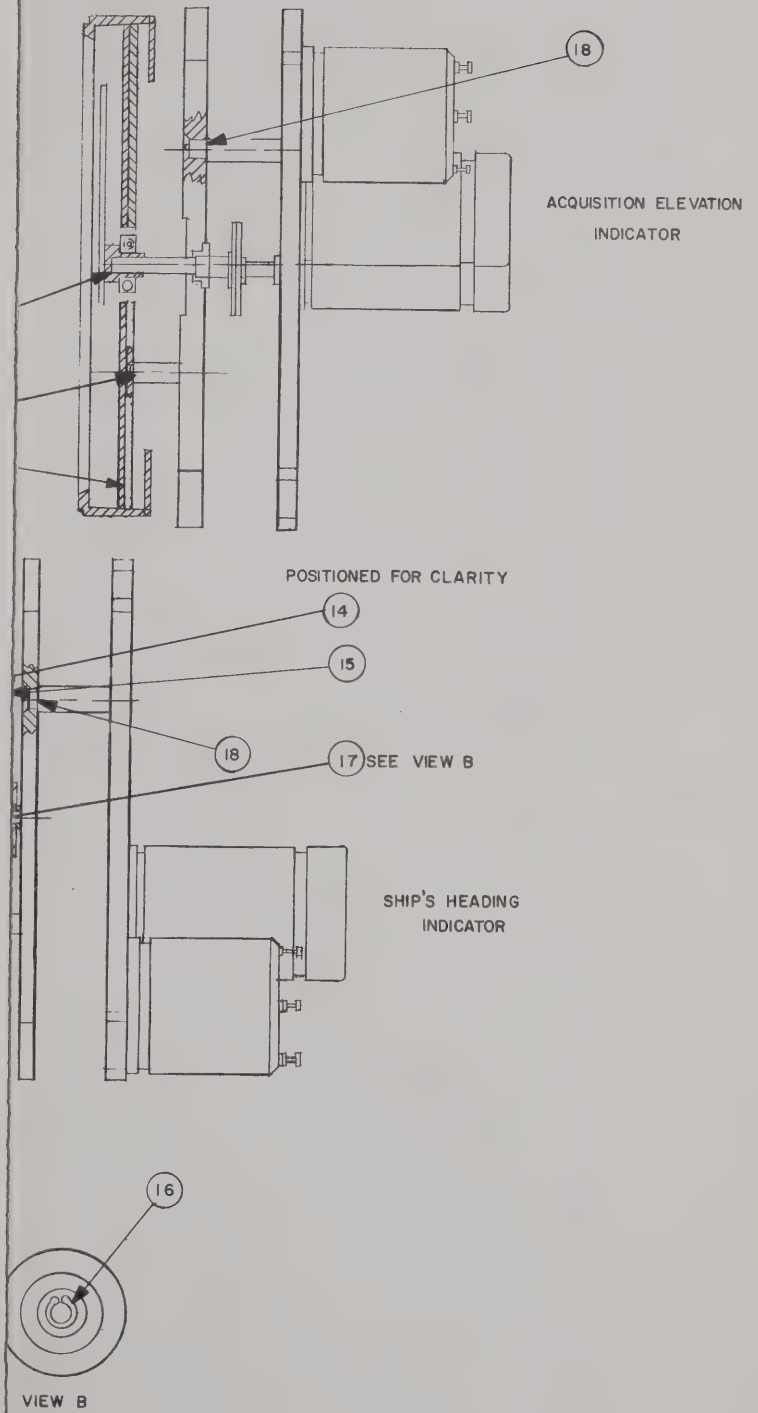


Figure 5-3. Indicator Mechanical Assembly,  
Cross-Sectional View





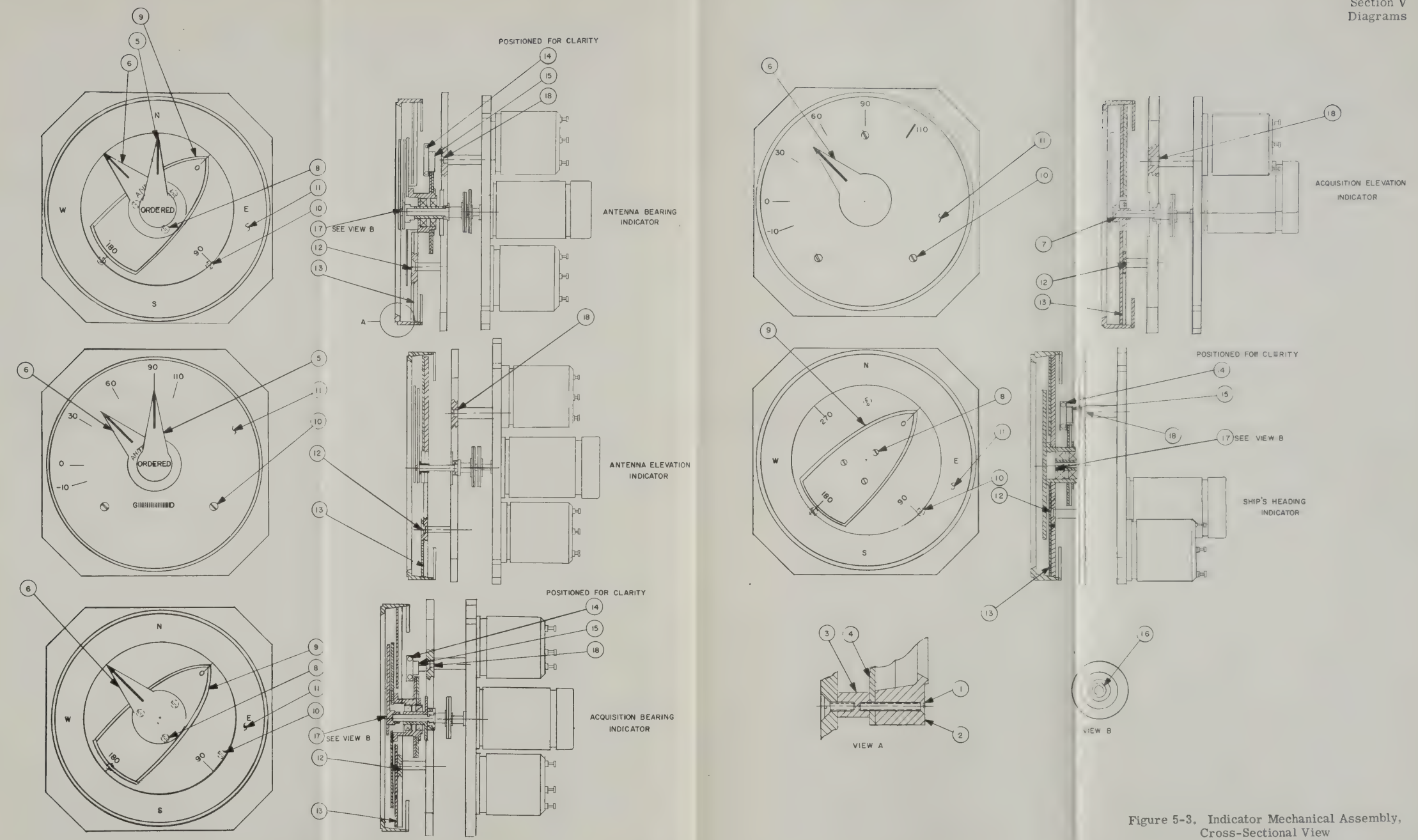


Figure 5-3. Indicator Mechanical Assembly, Cross-Sectional View



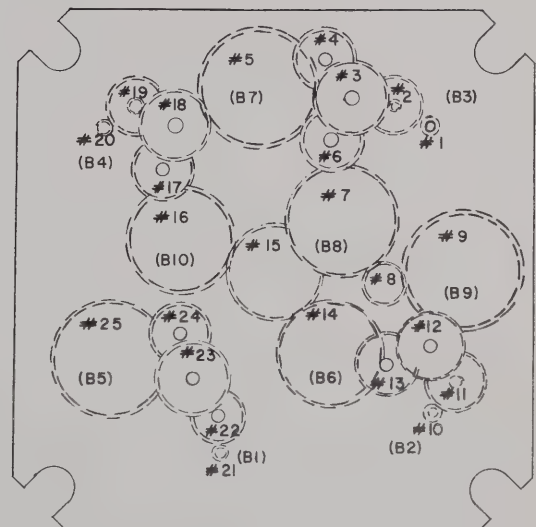
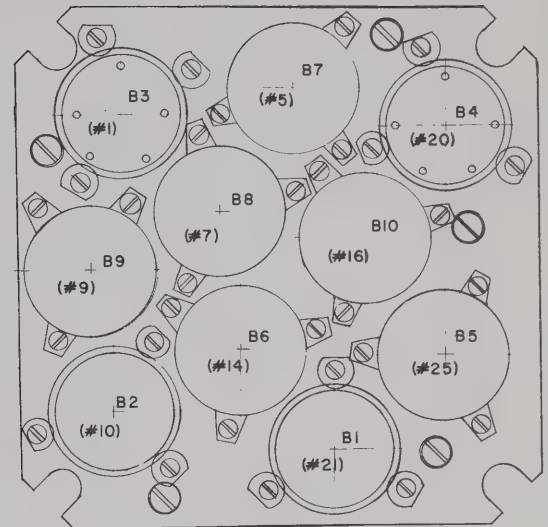
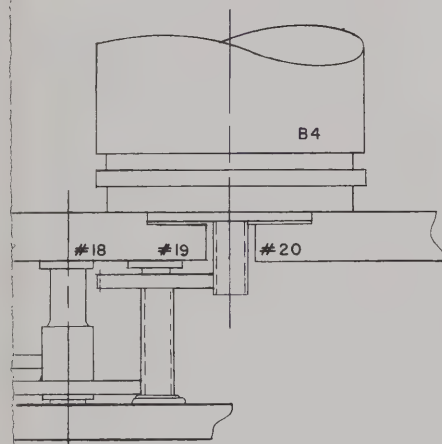
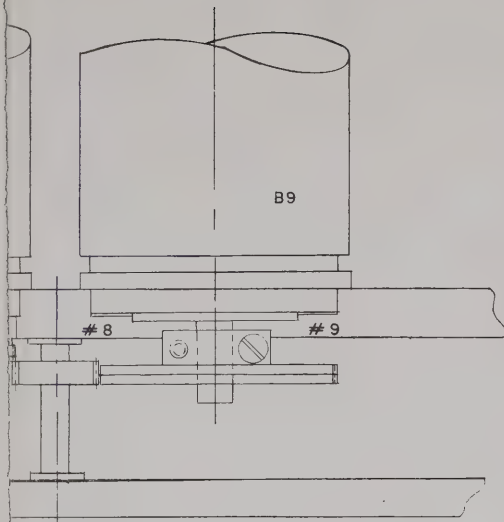


Figure 5-4a. Gear Train, Antenna  
Bearing Indicator





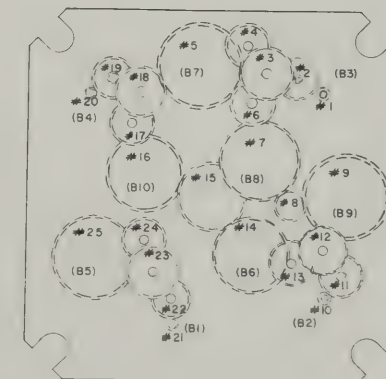
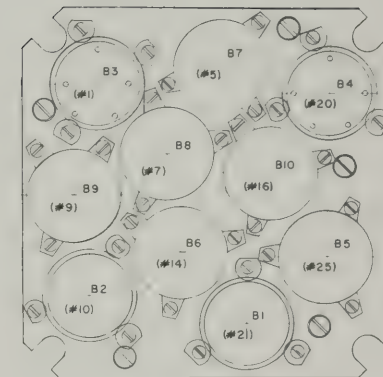
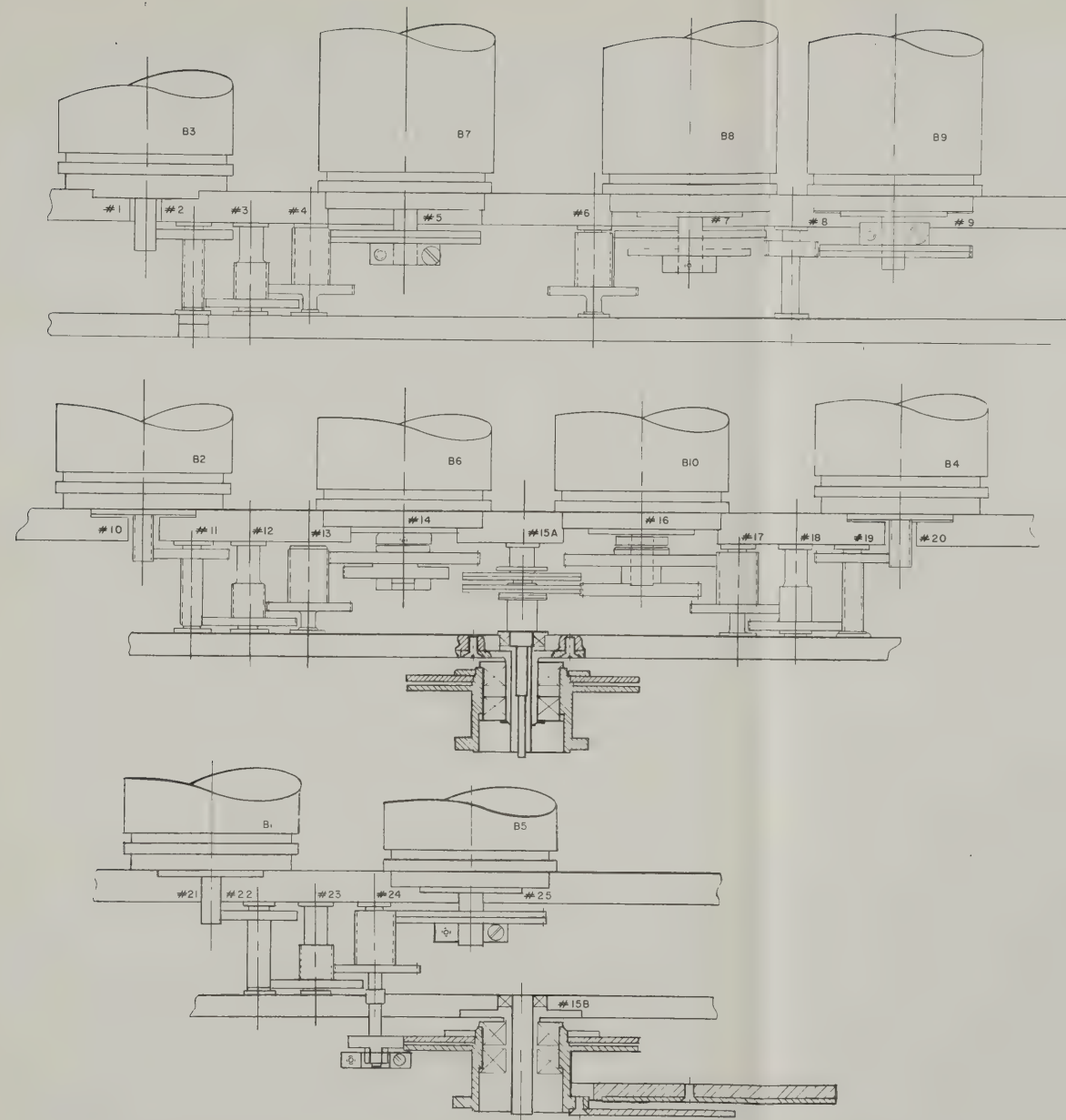


Figure 5-4a. Gear Train, Antenna  
Bearing Indicator

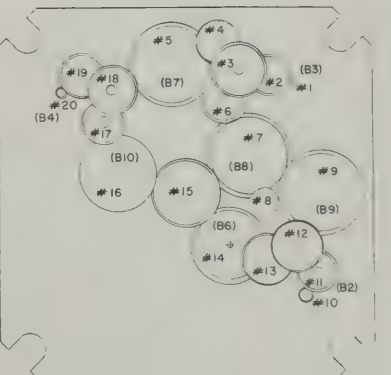
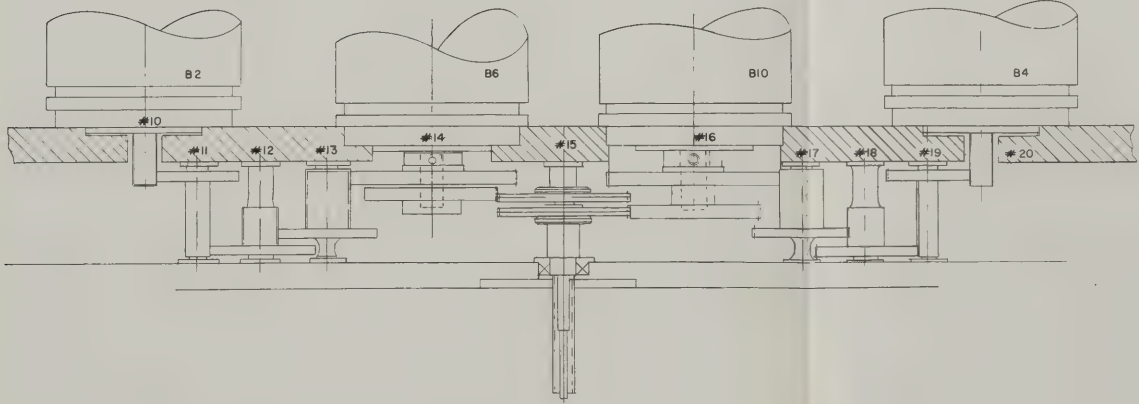
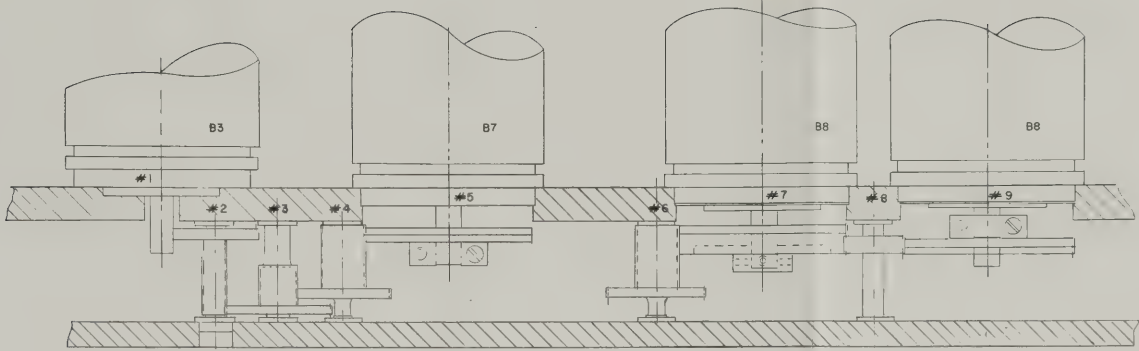


Figure 5-4b. Gear Train, Antenna  
Elevation Indicator

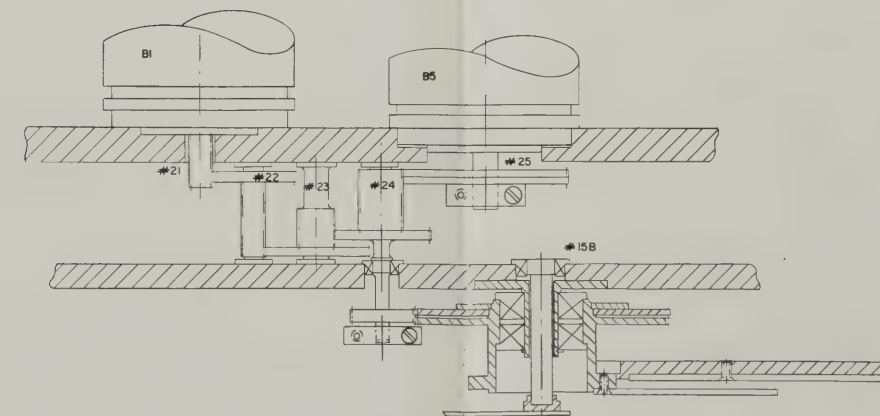
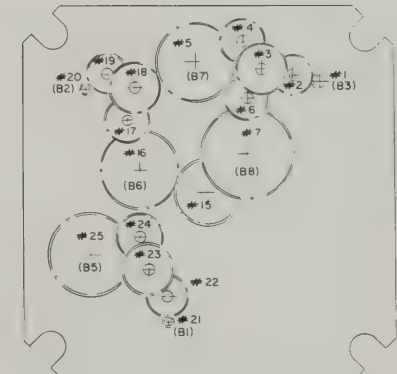
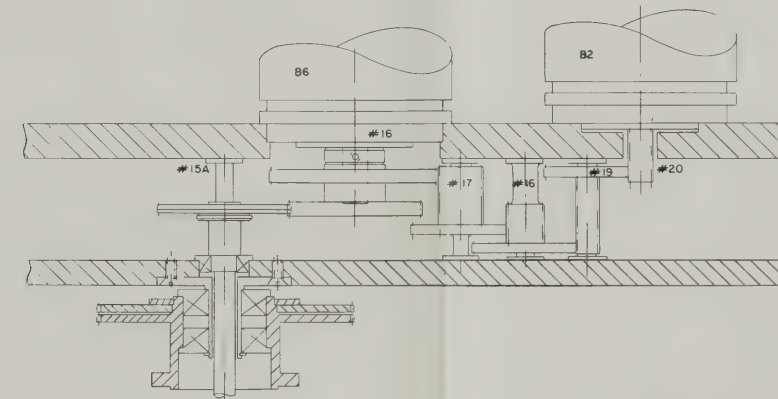
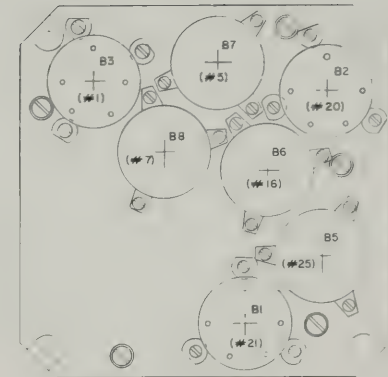
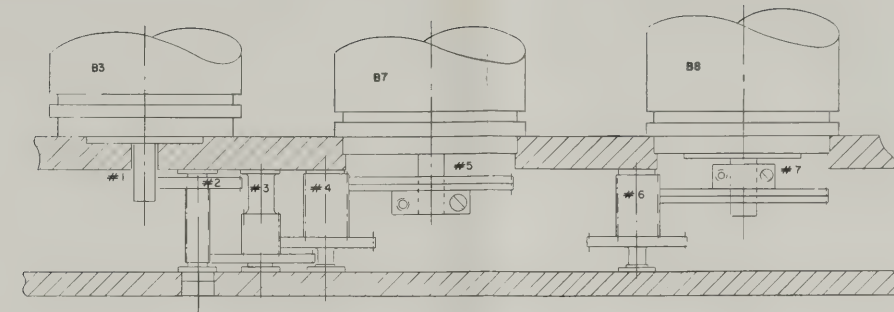


Figure 5-4c. Gear Train, Acquisition  
Bearing Indicator

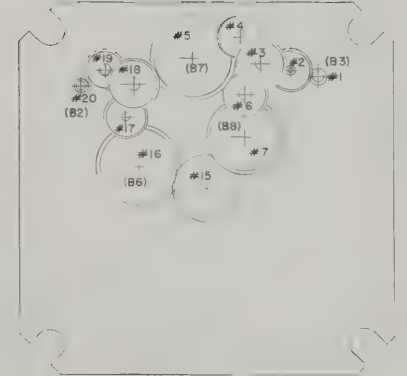
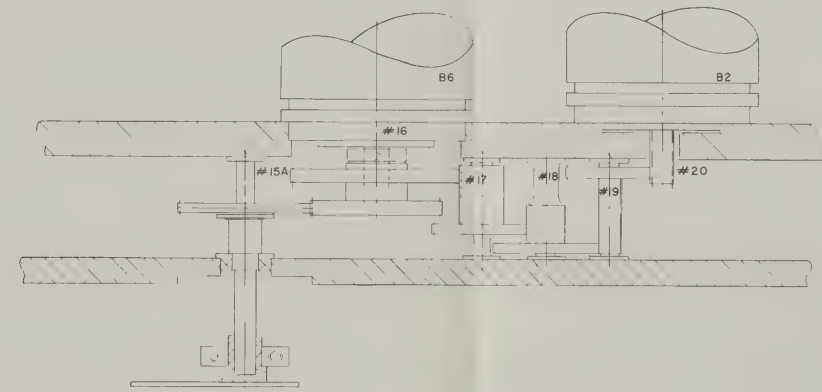
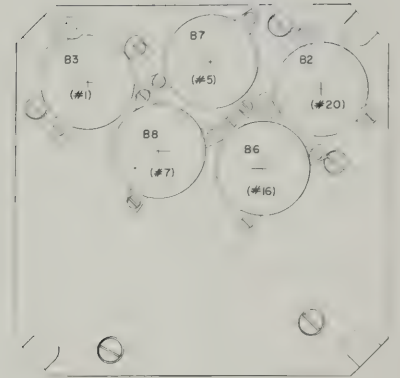
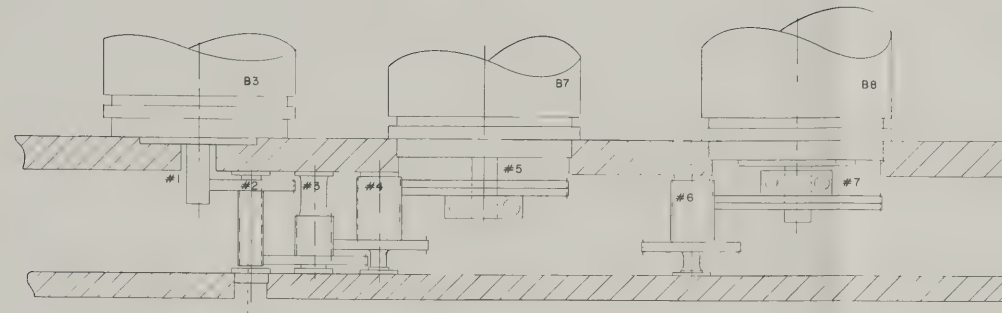


Figure 5-4d. Gear Train, Acquisition  
Elevation Indicator



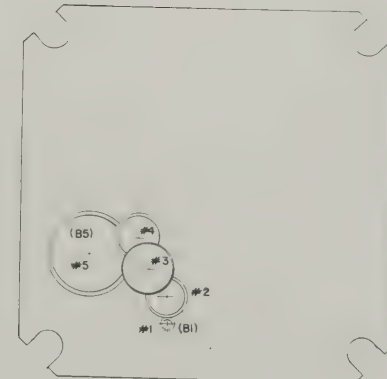
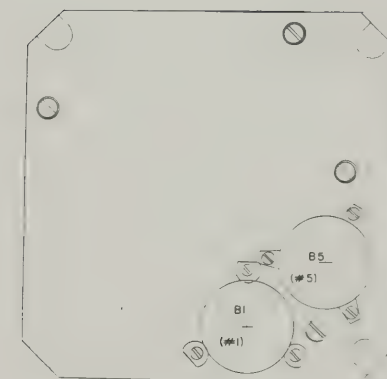
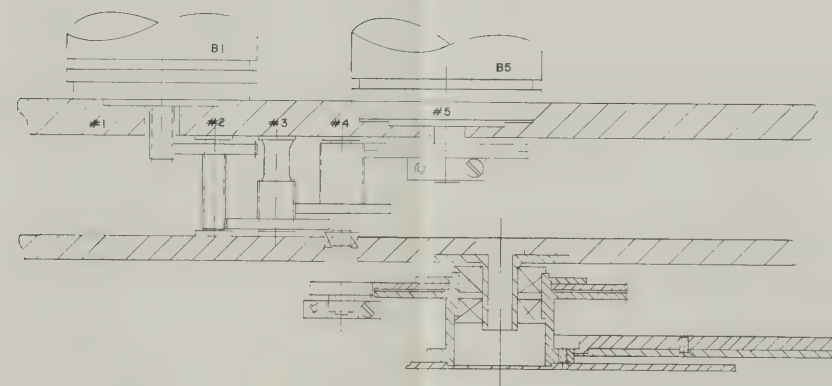
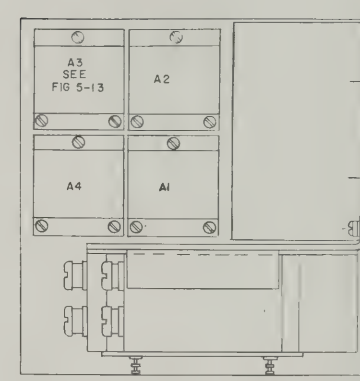
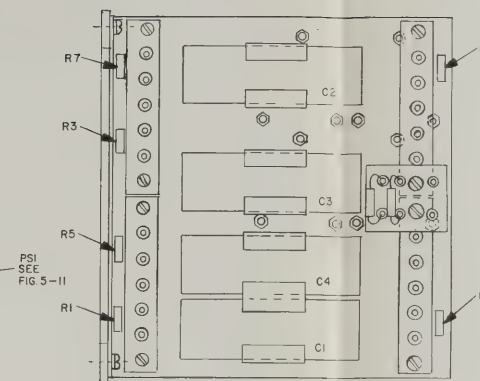
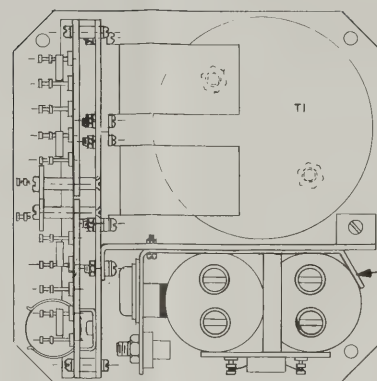
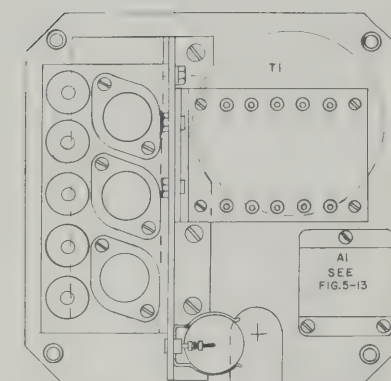


Figure 5-4e. Gear Train, Ship's  
Heading Indicator

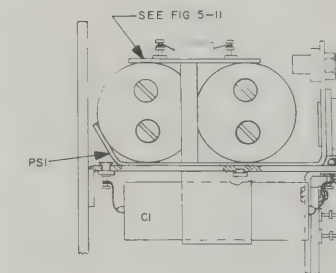
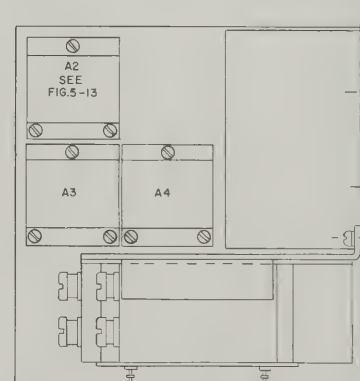
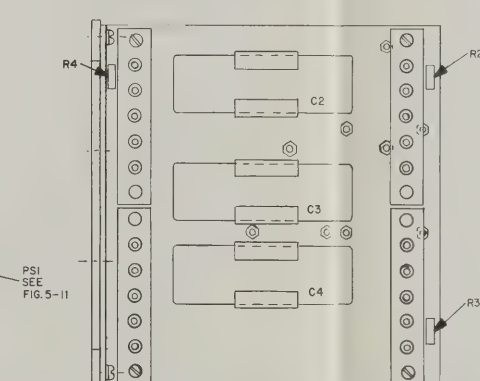
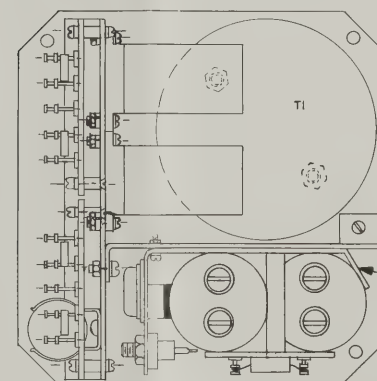
SEE FIG 5-6  
ELECTRONIC  
SCHEMATIC  
ANTENNA BEARING INDICATOR



SEE FIG 5-10  
ELECTRONIC  
SCHEMATIC  
SHIP'S HEADING  
INDICATOR



SEE FIG 5-7  
OR FIG 5-8  
ELECTRONIC  
SCHEMATIC  
ANTENNA ELEVATION INDICATOR  
ACQUISITION BEARING INDICATOR



SEE FIG 5-9  
ELECTRONIC  
SCHEMATIC  
ACQUISITION ELEVATION INDICATOR

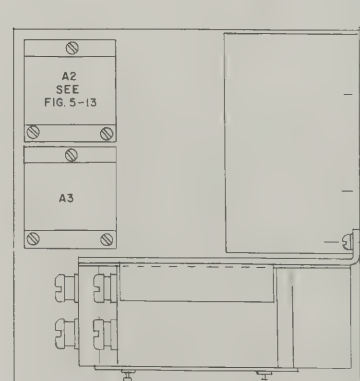
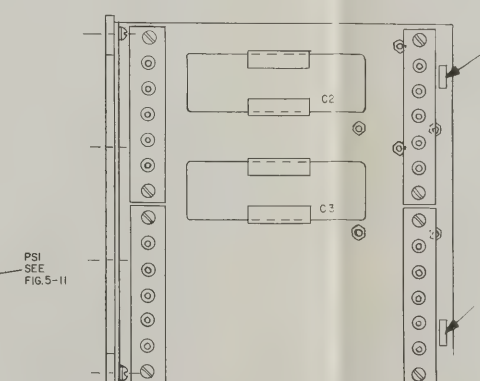
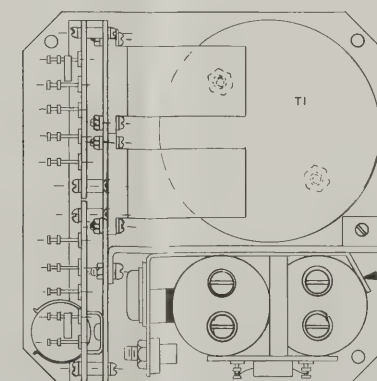


Figure 5-5. Electronic Assembly,  
Cross-Sectional View



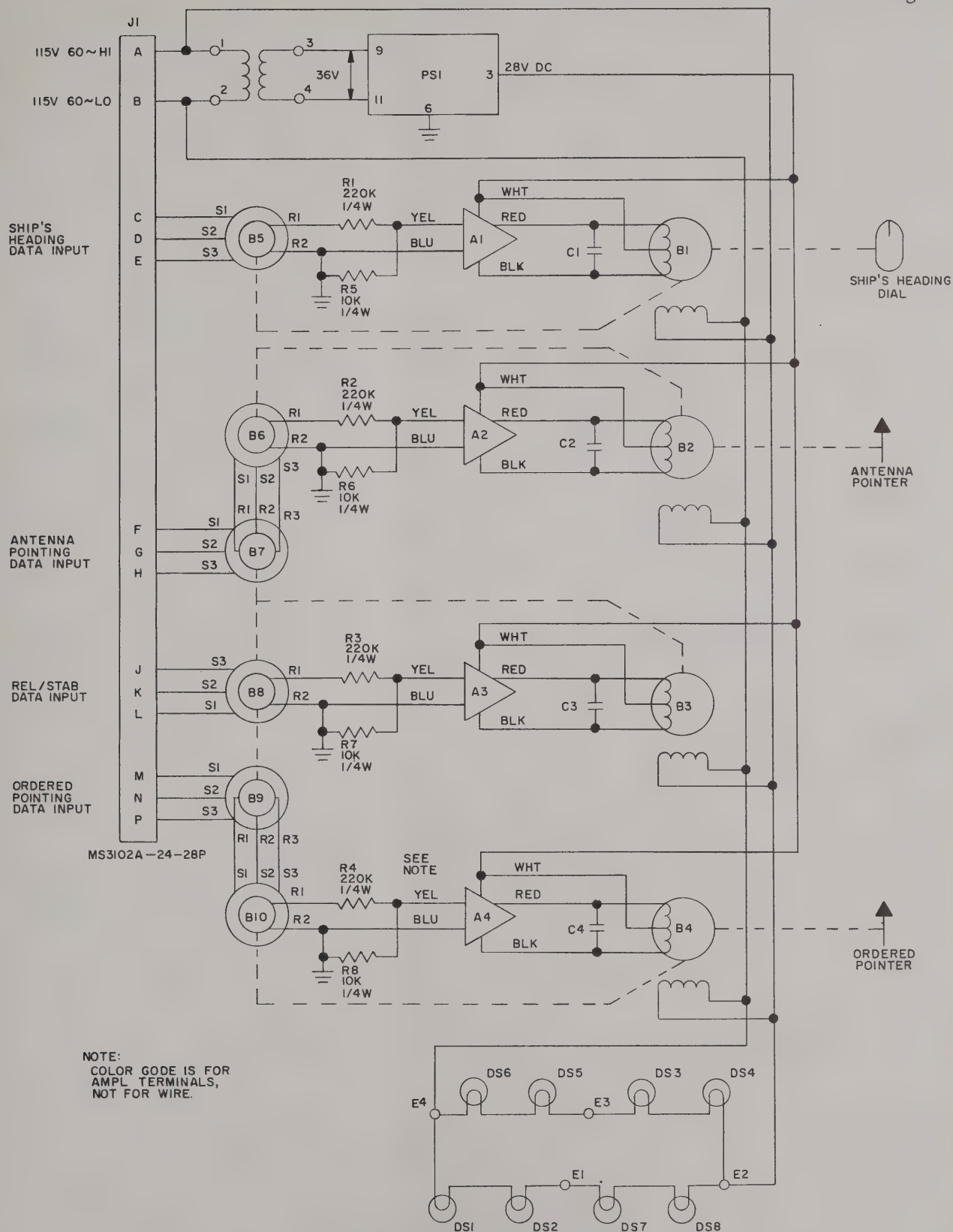


Figure 5-6. Schematic Diagram,  
Antenna Bearing Indicator



# Section V Diagrams

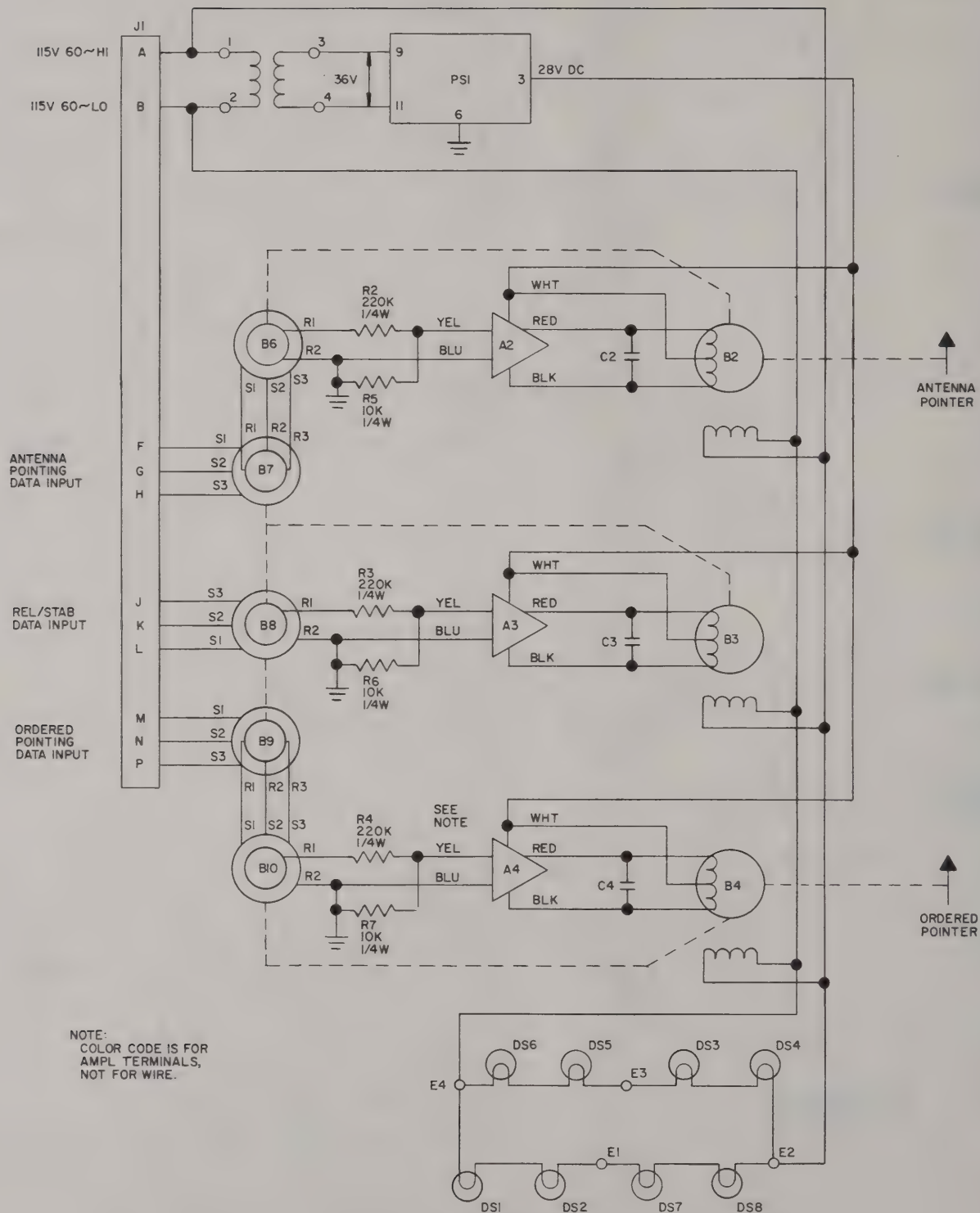


Figure 5-7. Schematic Diagram,  
Antenna Elevation Indicator

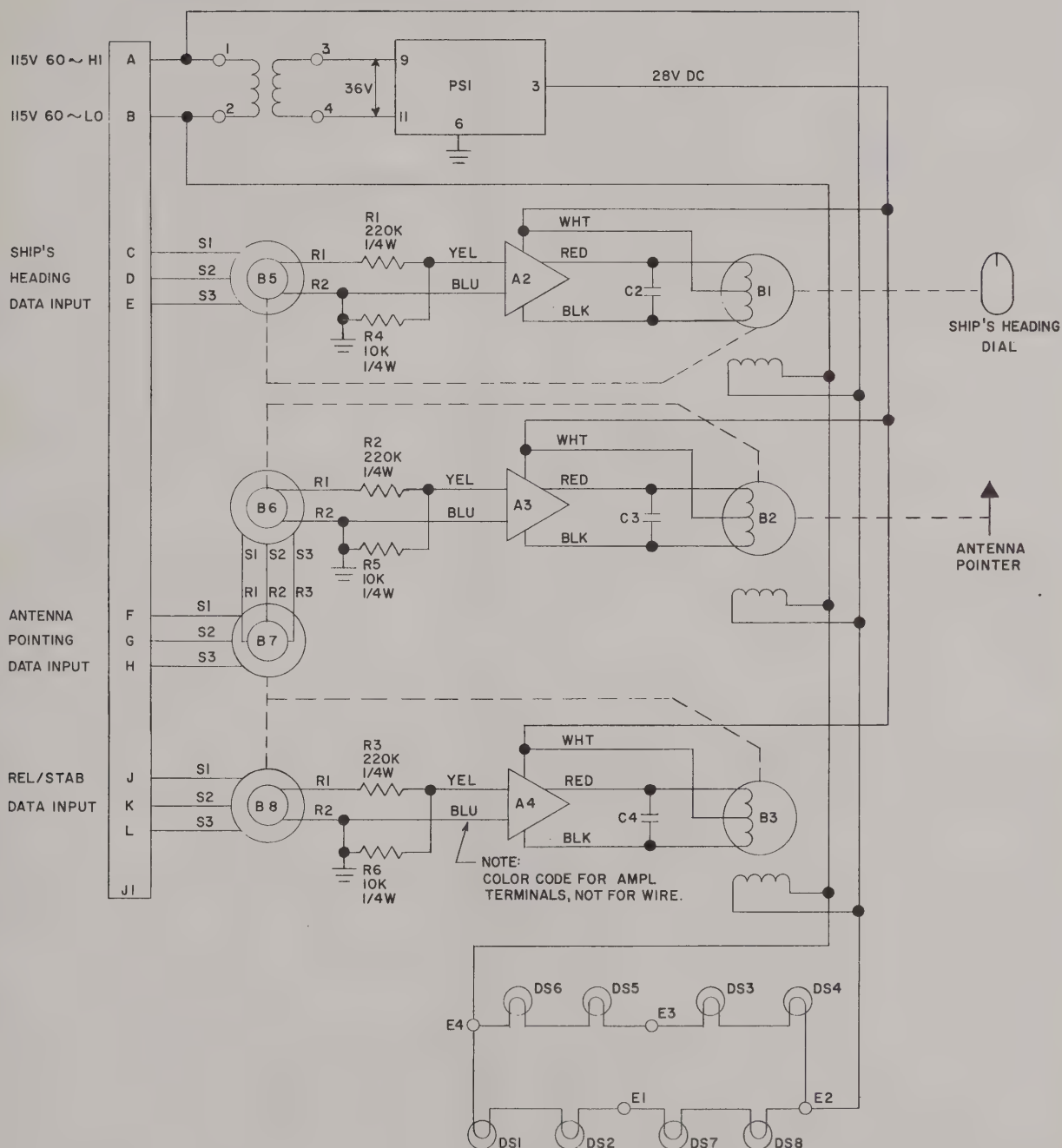


Figure 5-8. Schematic Diagram,  
Acquisition Bearing Indicator

Section V  
Diagrams

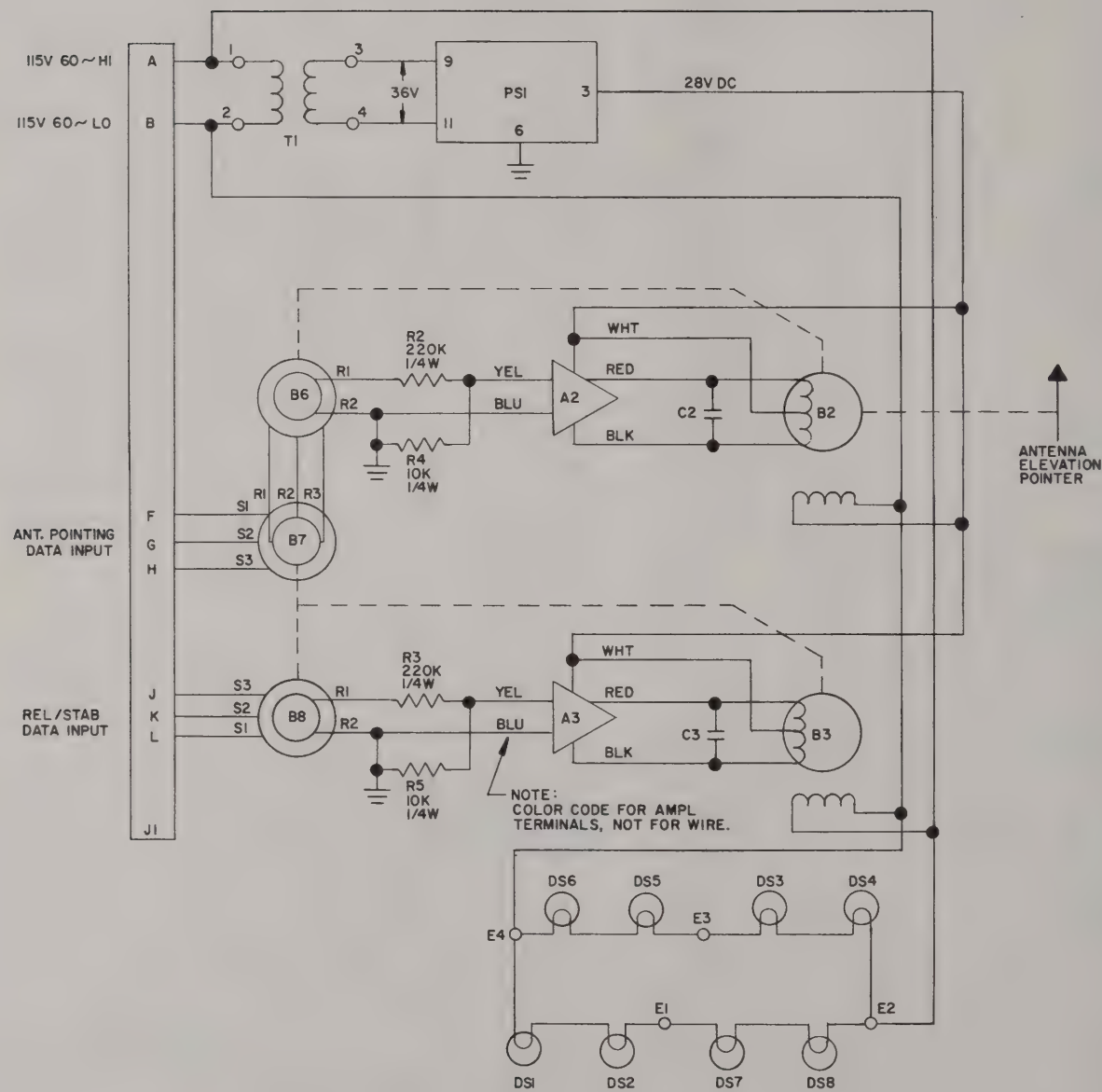


Figure 5-9. Schematic Diagram,  
Acquisition Elevation Indicator

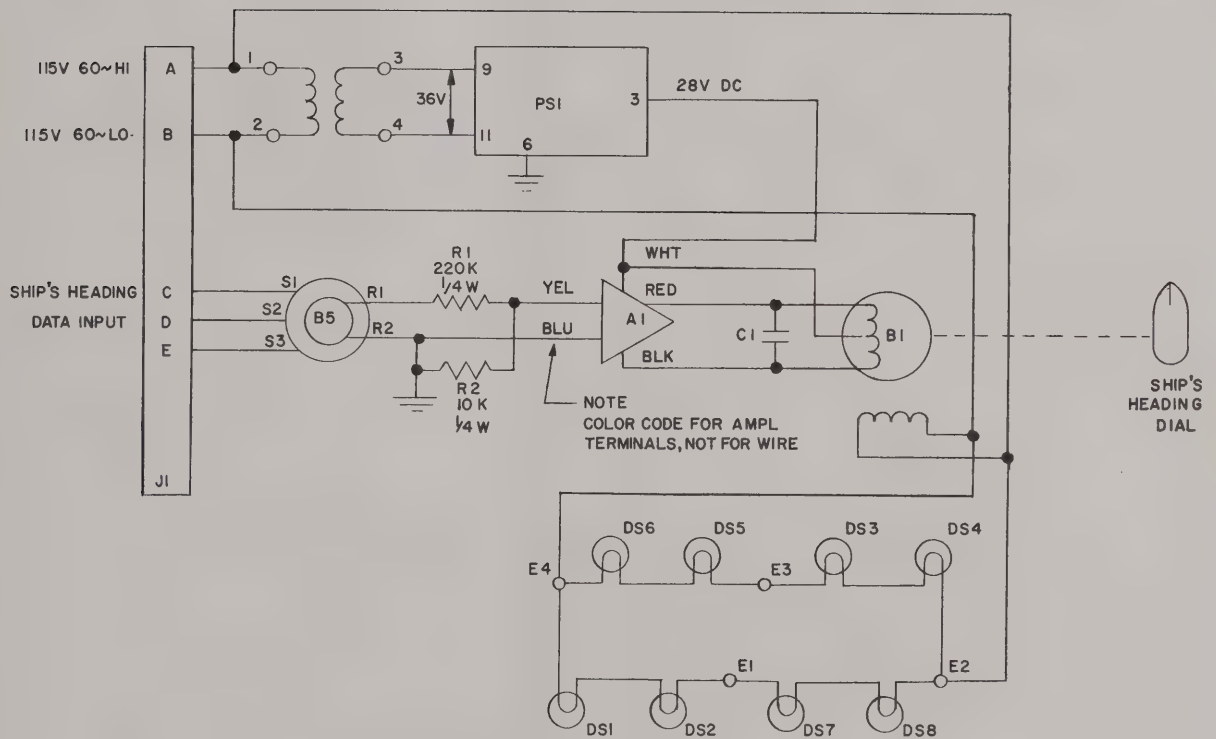


Figure 5-10. Schematic Diagram,  
Ship's Heading Indicator



Section V  
Diagrams

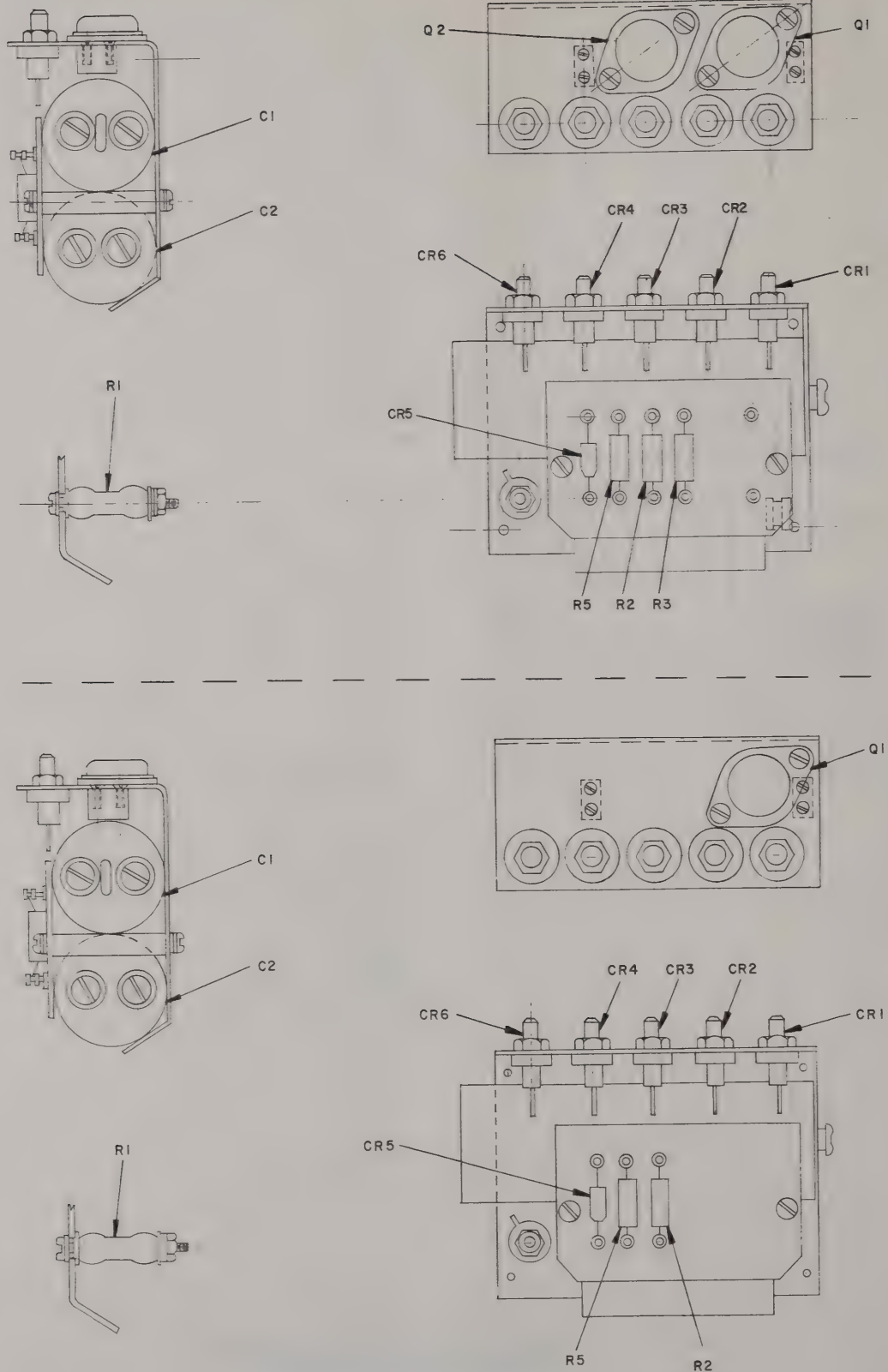


Figure 5-11. Power Supply,  
Cross-Sectional Views

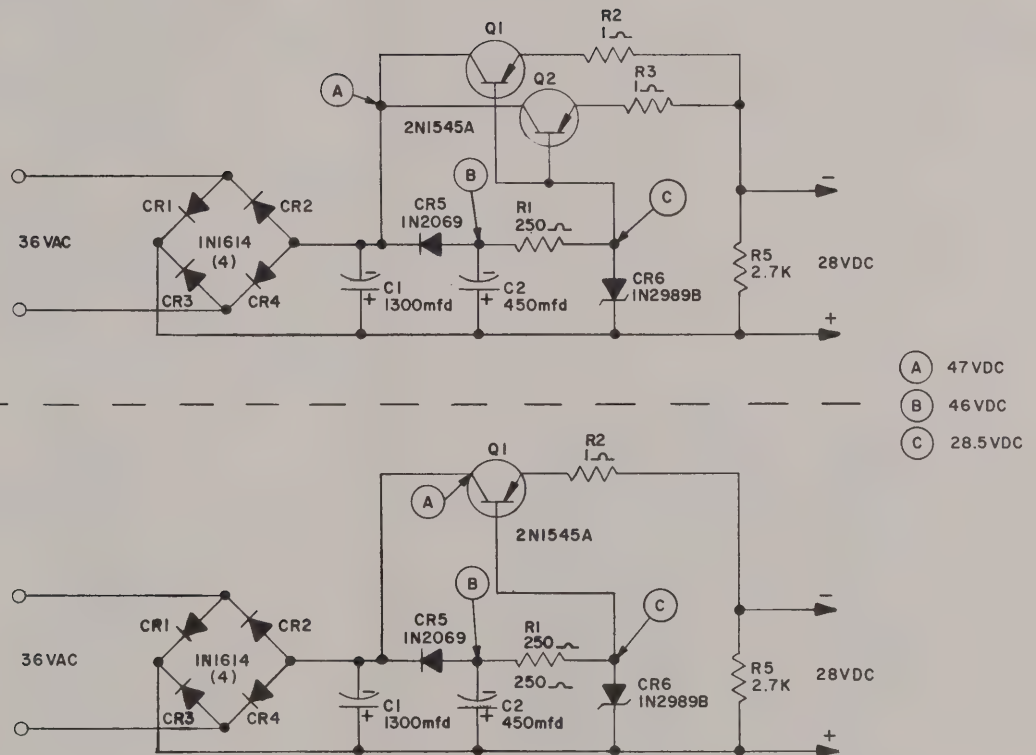


Figure 5-12. Power Supply, Schematic Diagram



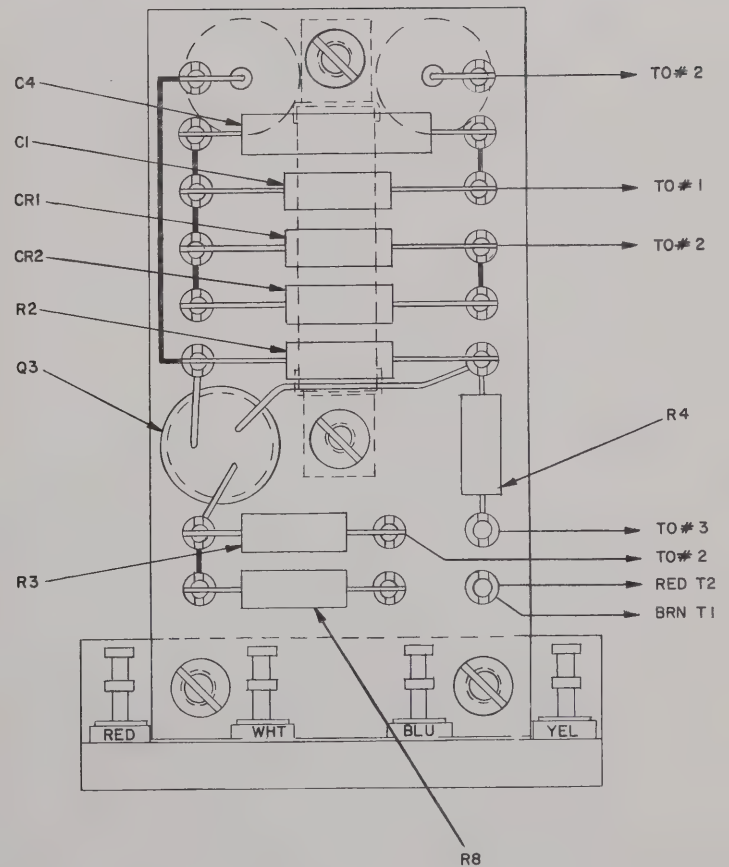
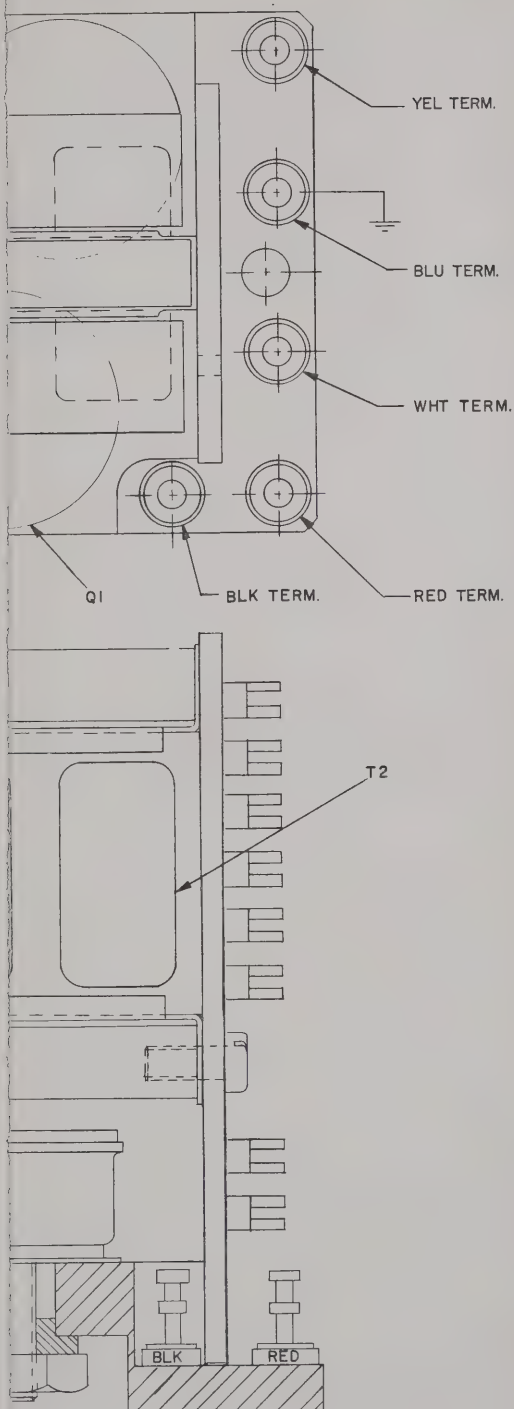


Figure 5-13. Amplifier Assembly,  
Cross-Sectional View





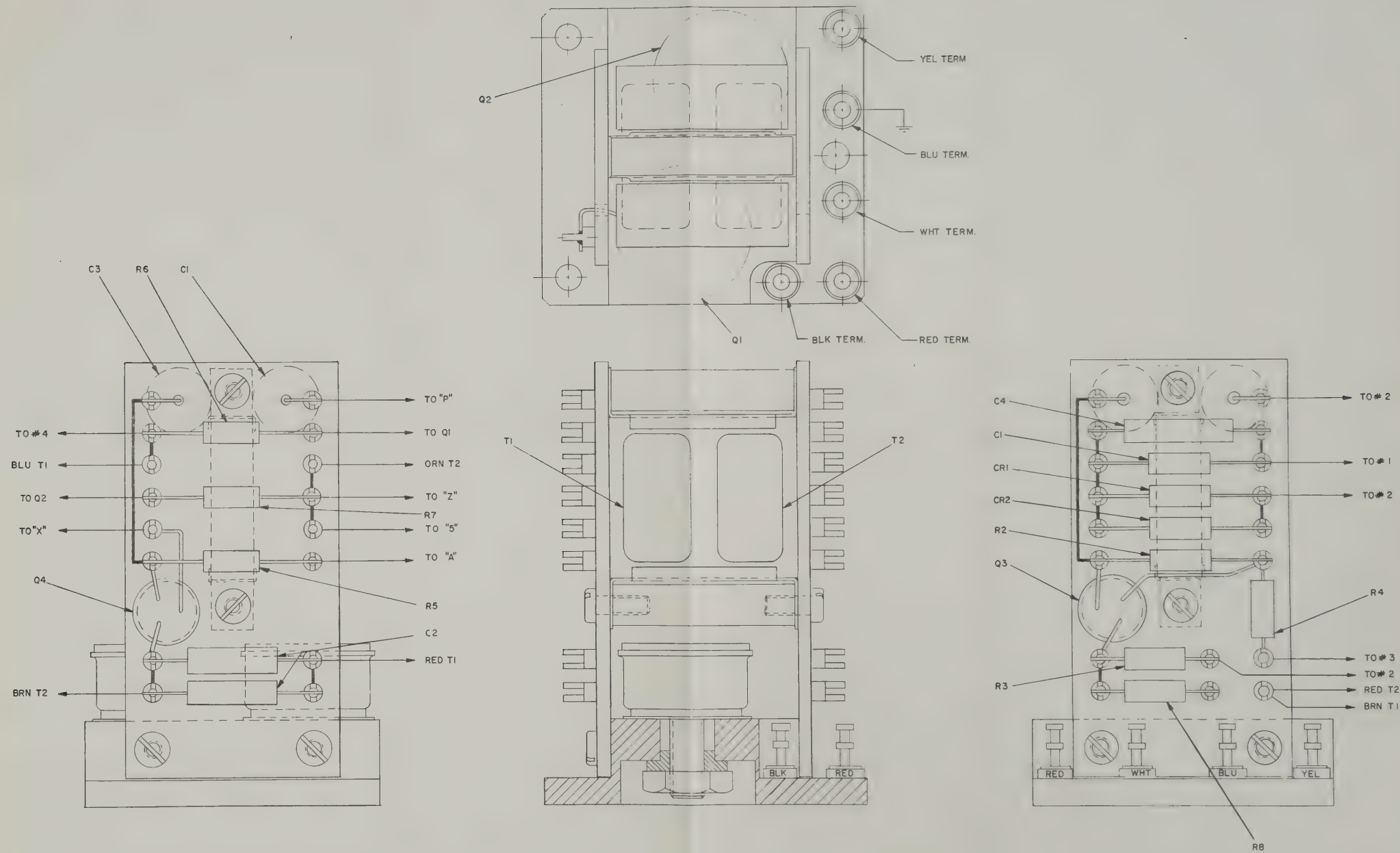


Figure 5-13. Amplifier Assembly,  
Cross-Sectional View

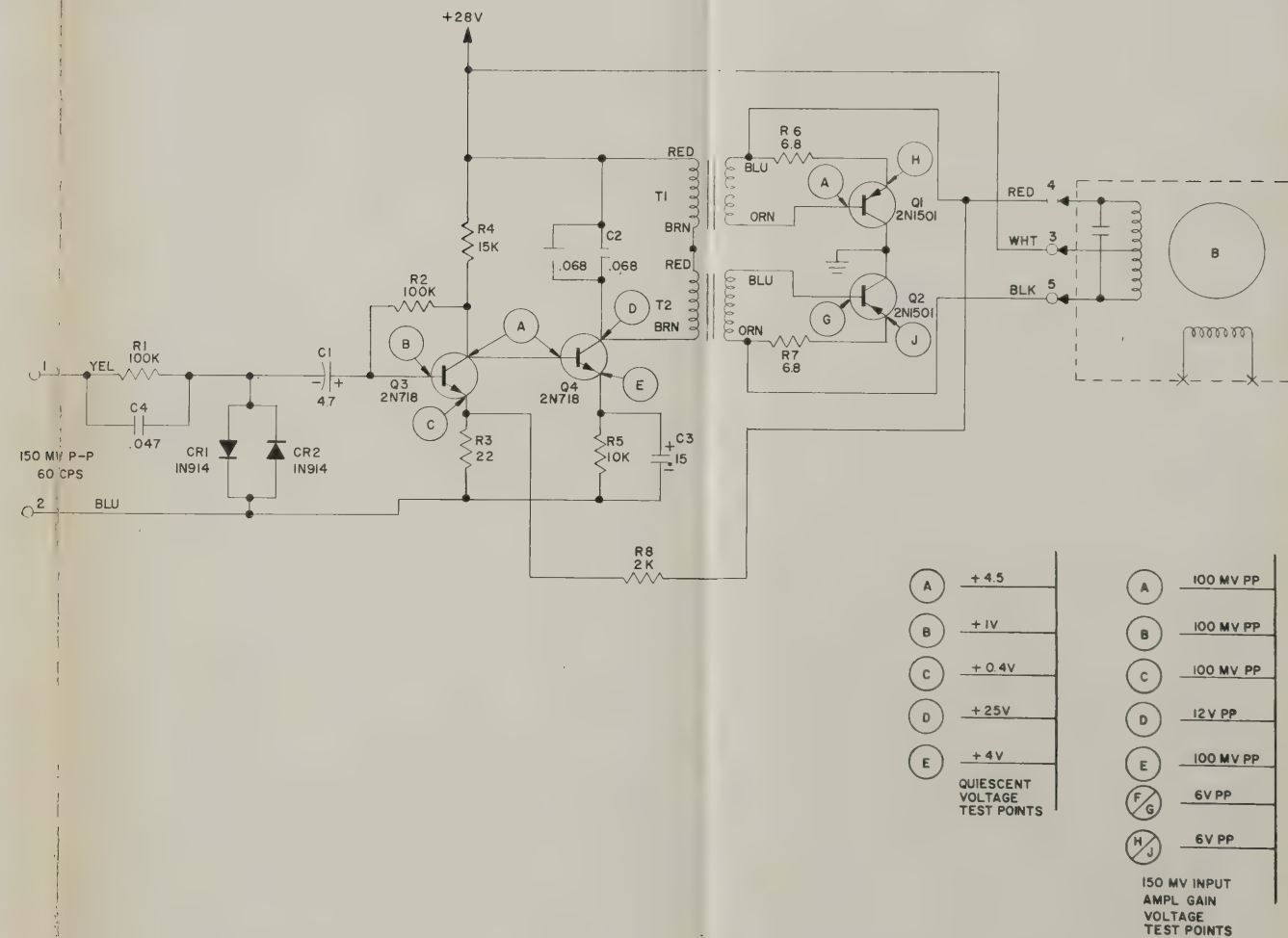


Figure 5-14. Amplifier Assembly,  
Schematic Diagram

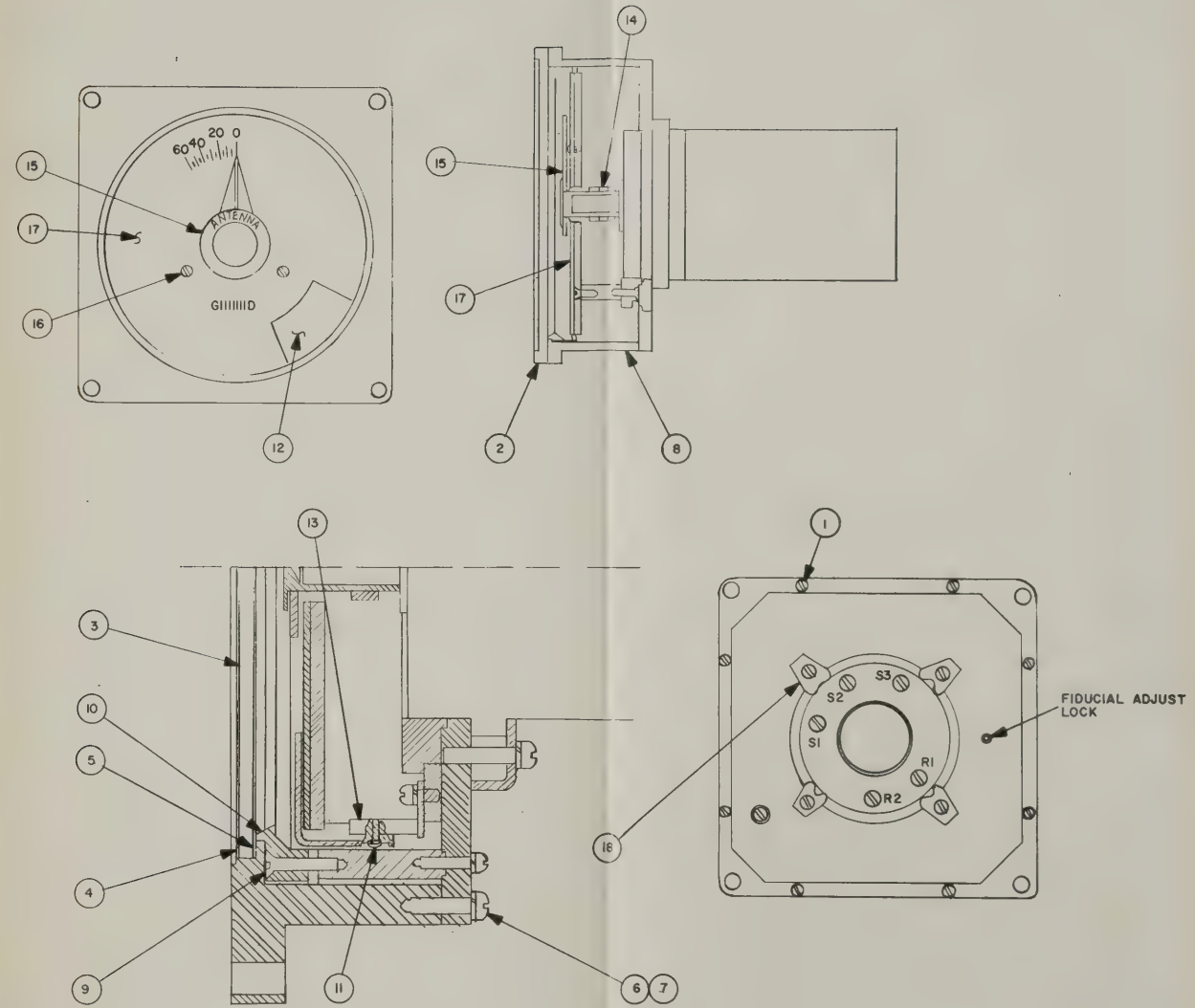


Figure 5-15. Follower-Type Indicator,  
Cross-Sectional View





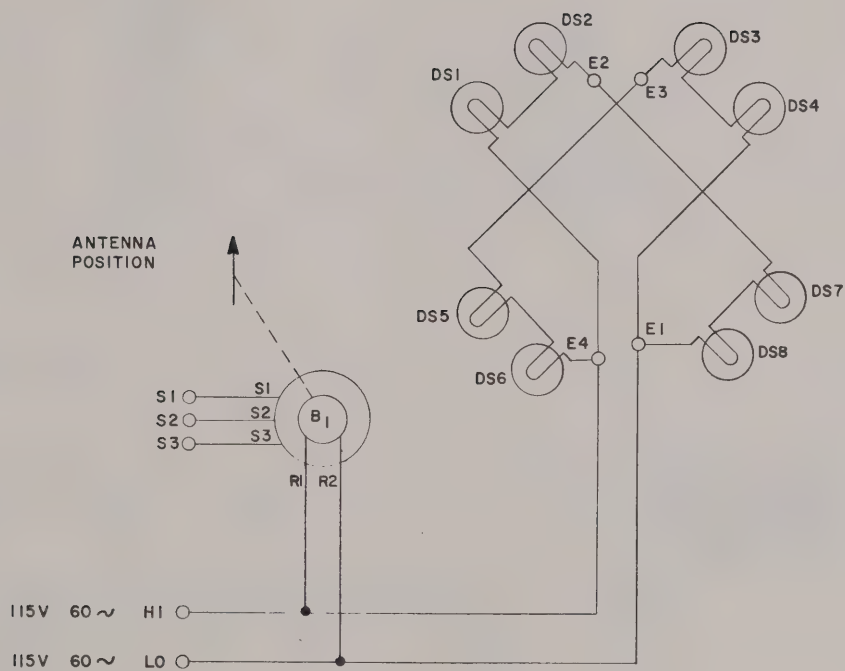


Figure 5-16. Schematic Diagram,  
Follower-Type Indicator



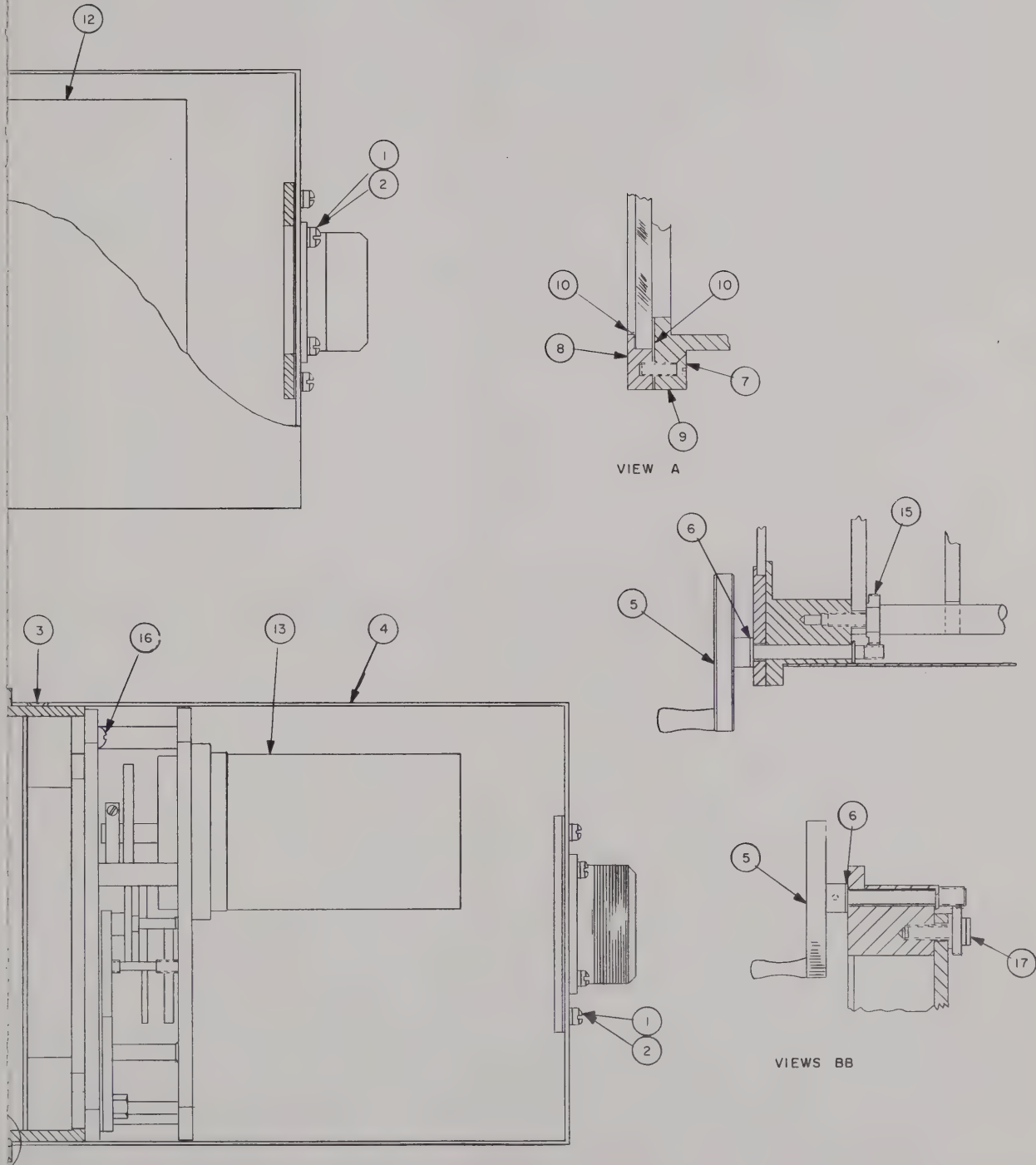


Figure 5-17. Control-Type Indicator,  
Cross-Sectional View





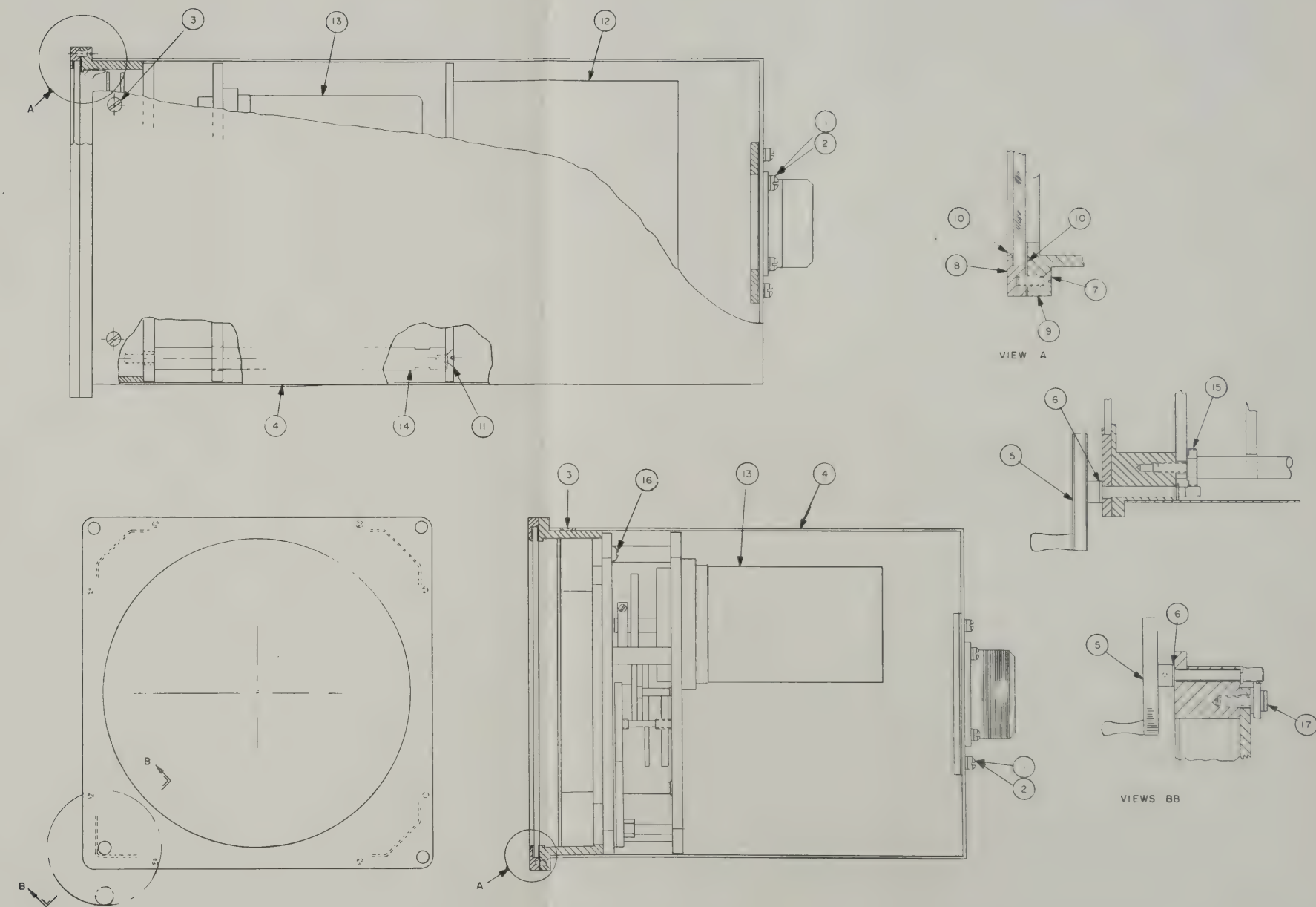


Figure 5-17. Control-Type Indicator,  
Cross-Sectional View

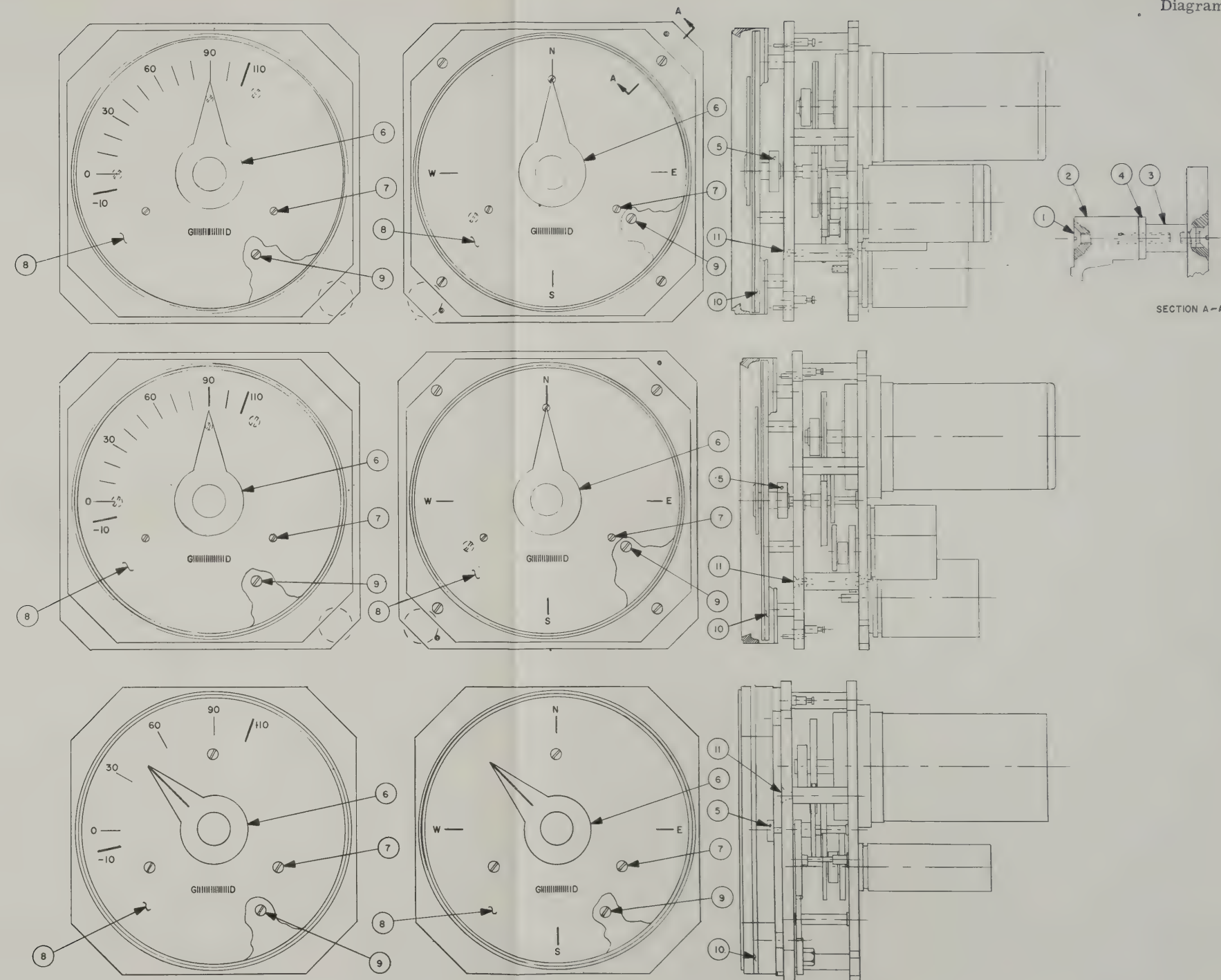


Figure 5-18. Indicator Mechanical Assembly,  
Cross-Sectional View

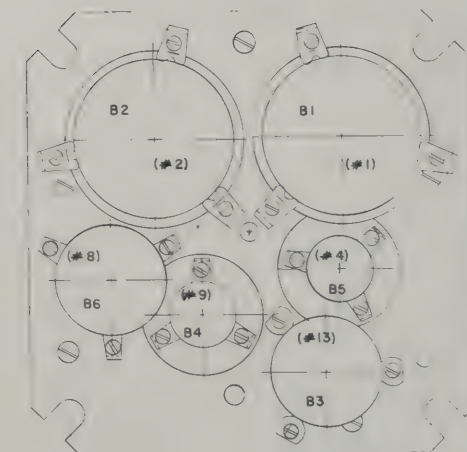
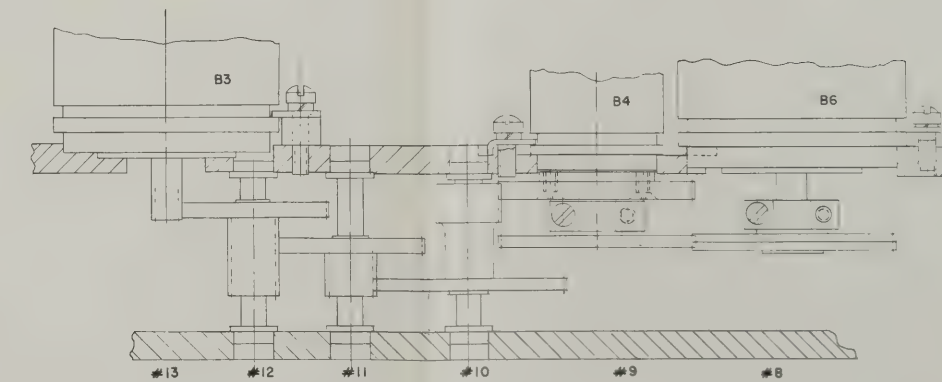
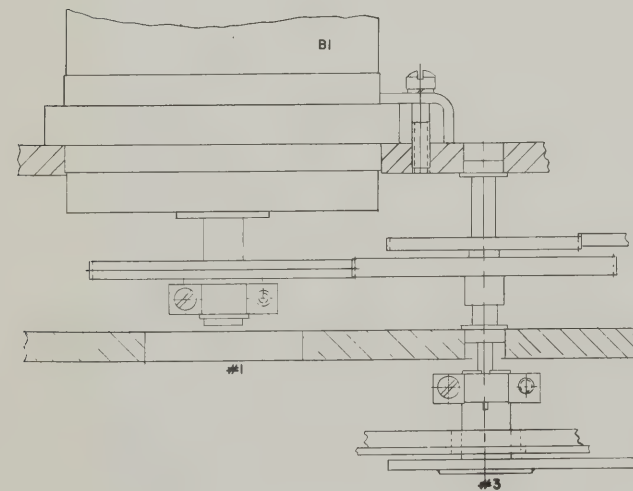
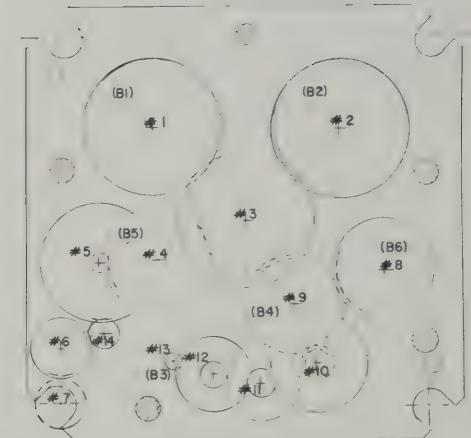
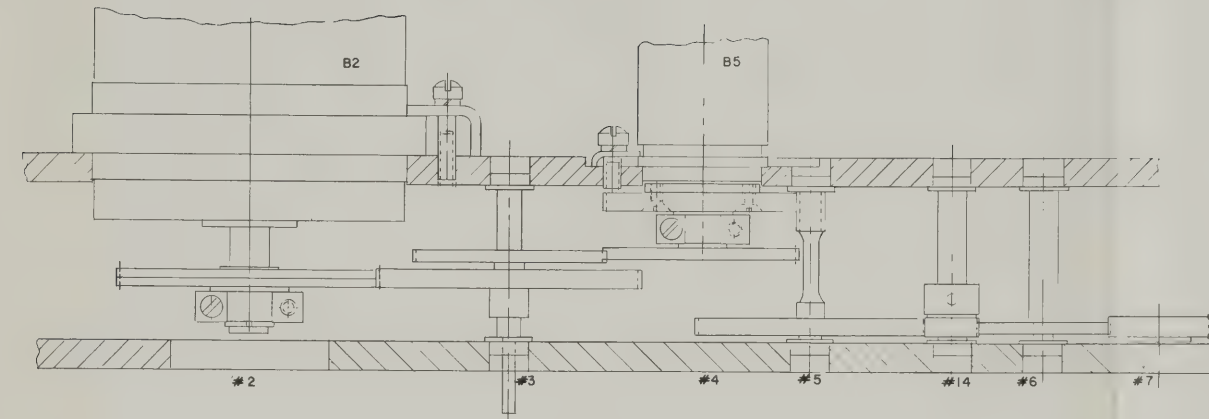


Figure 5-19a. Gear Train, Manual Ordered  
Bearing and Elevation Indicators



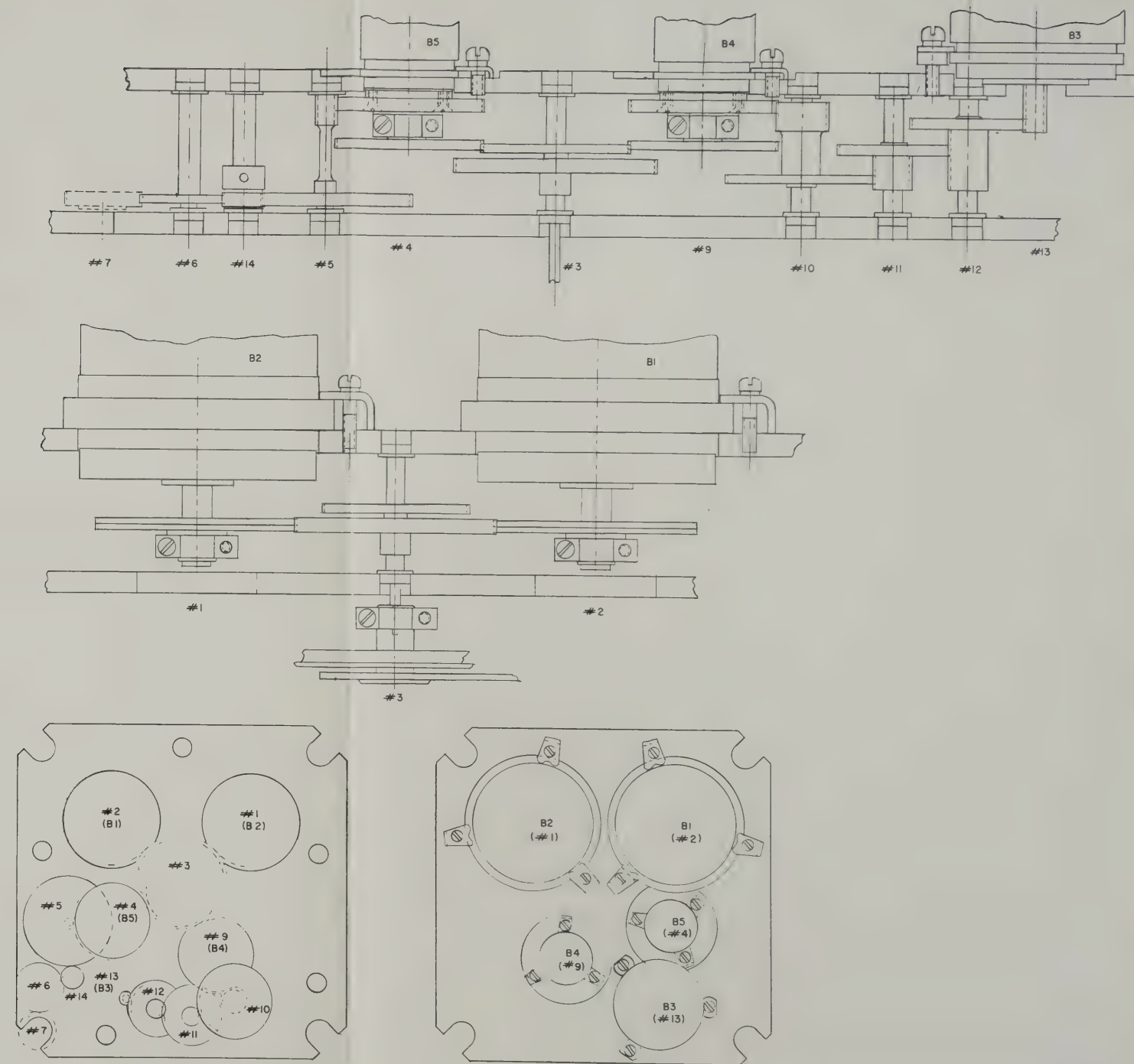


Figure 5-19b. Gear Train, Manual Ordered  
Bearing and Elevation  
Indicators - TM2

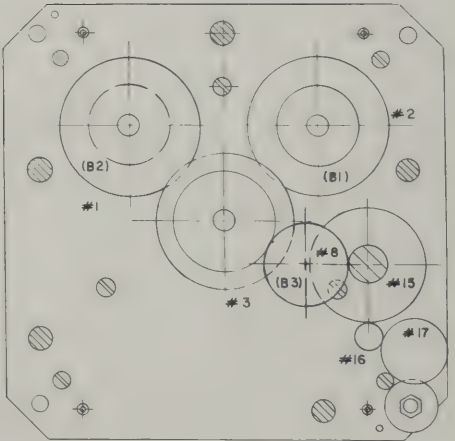
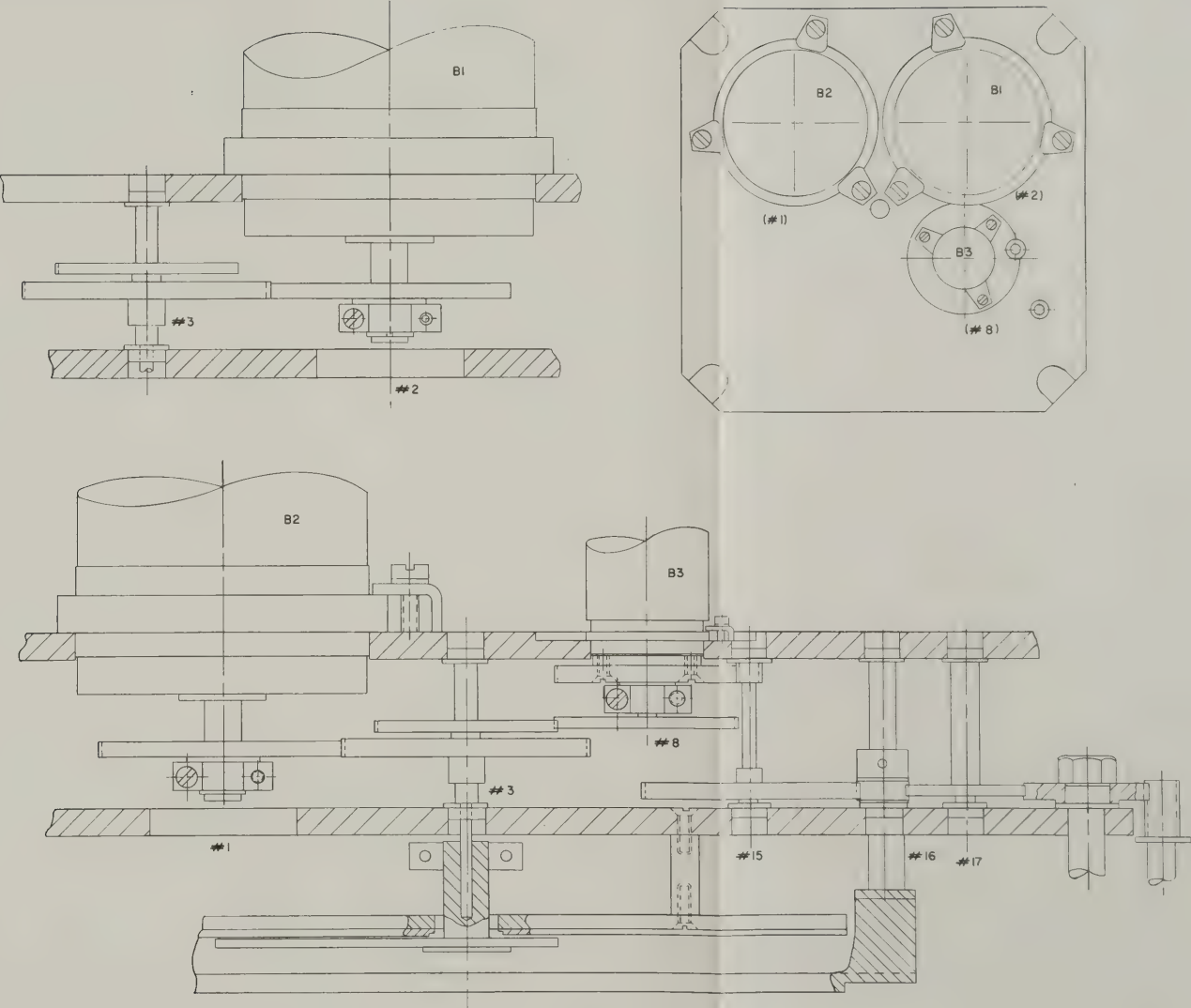
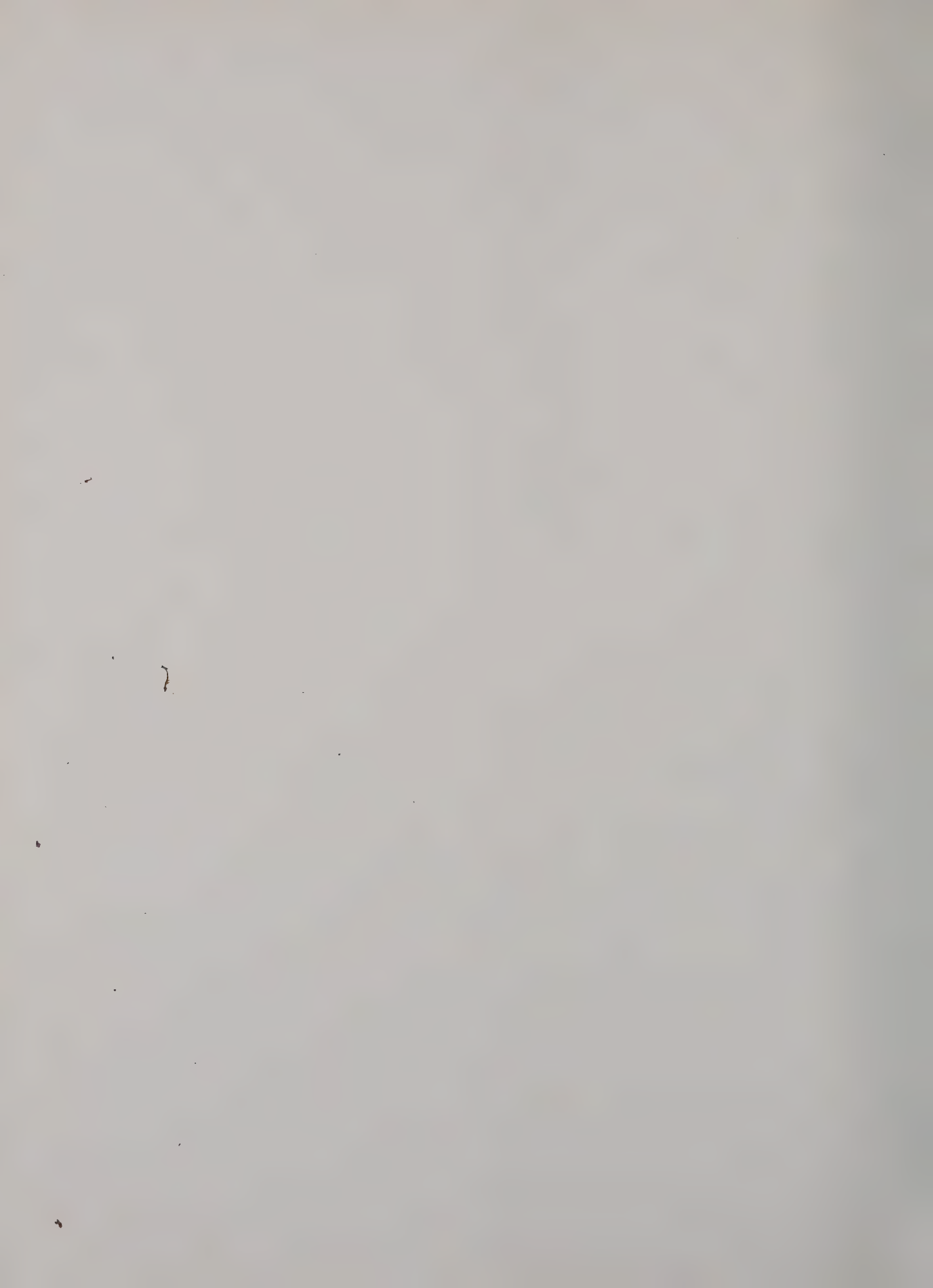


Figure 5-19c. Gear Train, Manual Ordered  
Bearing and Elevation Indicators -  
Command Control



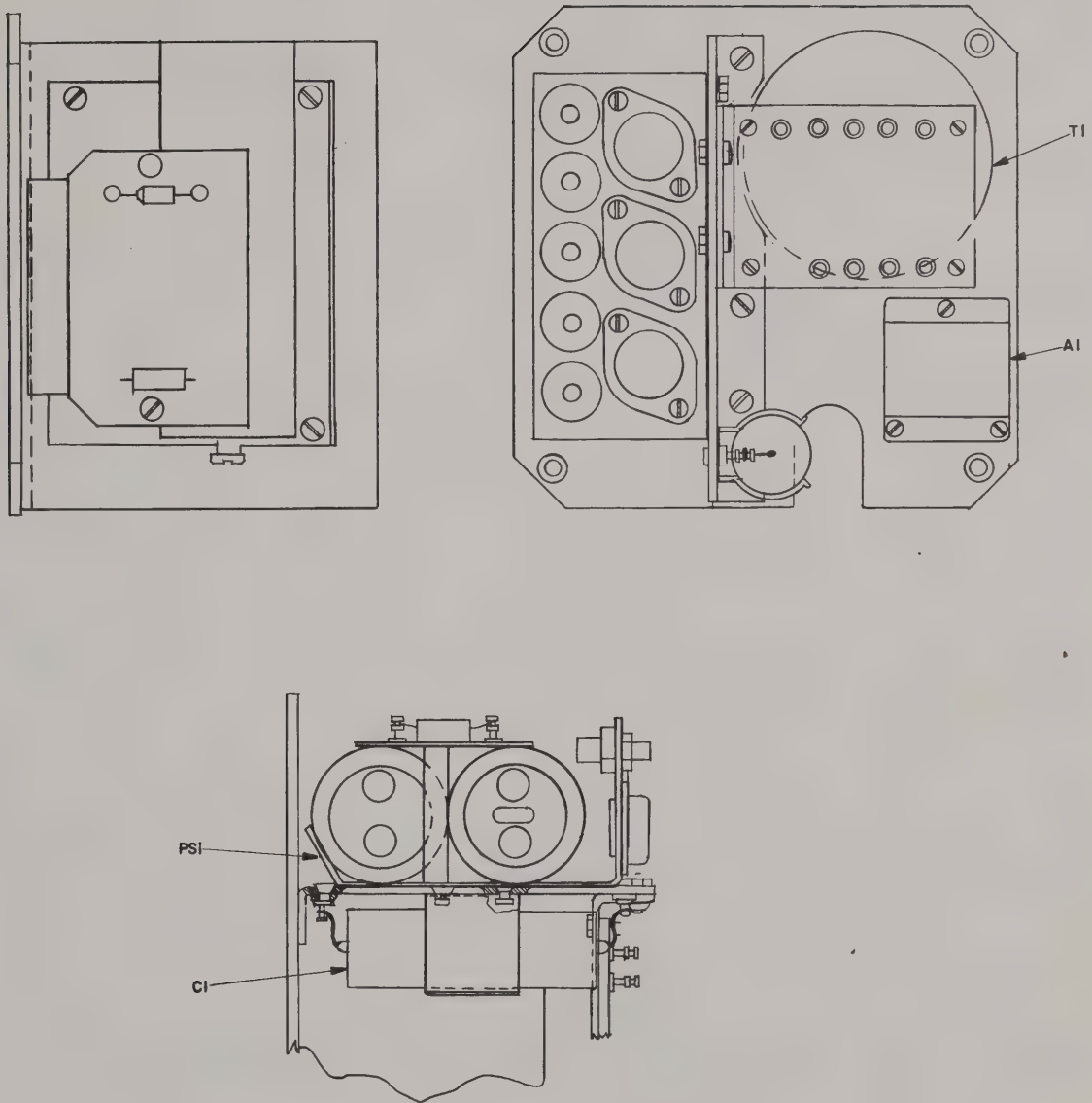


Figure 5-20. Electronic Assembly,  
Cross-Sectional View



# Section V Diagrams

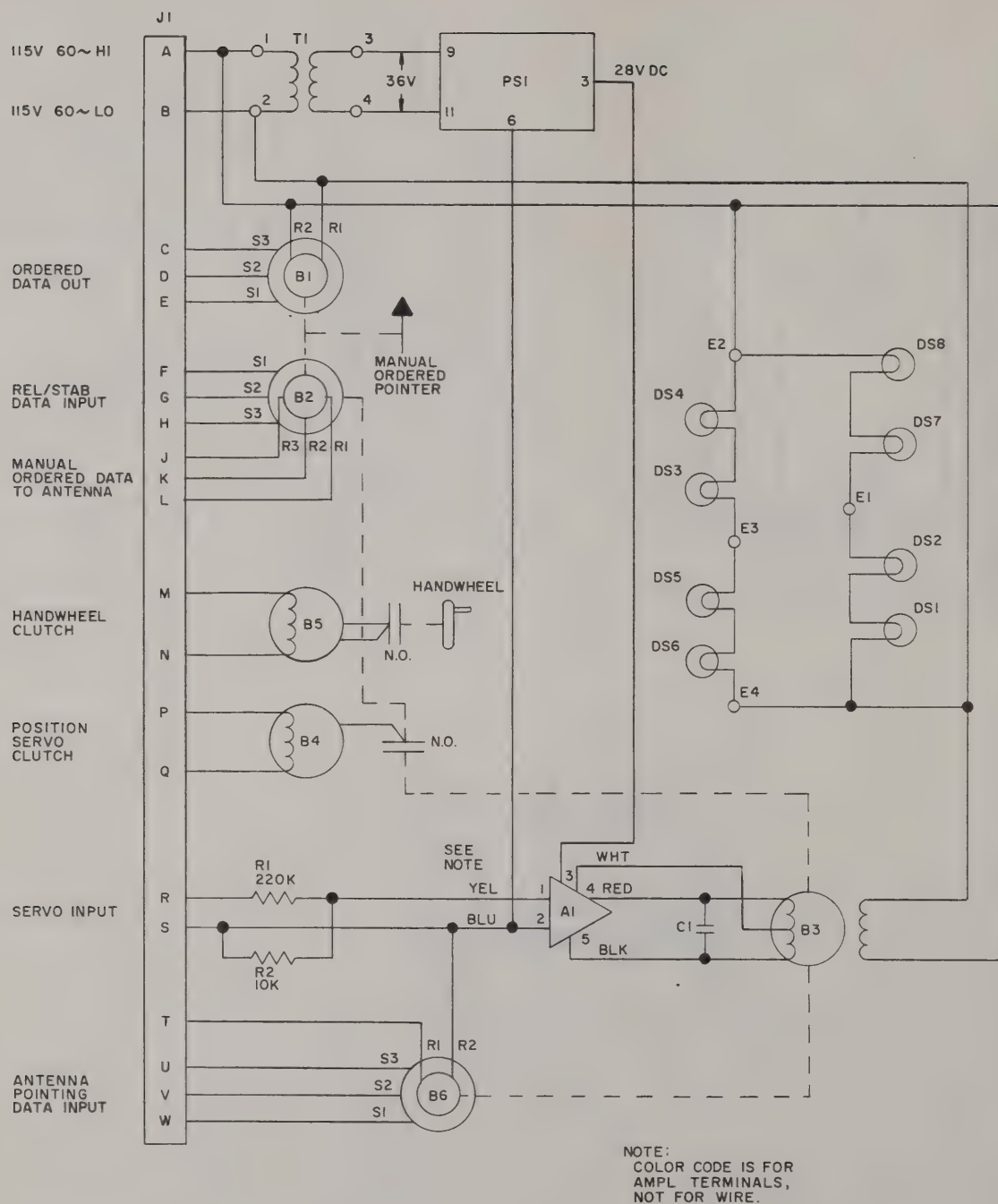


Figure 5-21. Schematic Diagram, Manual Ordered Bearing and Elevation Indicators

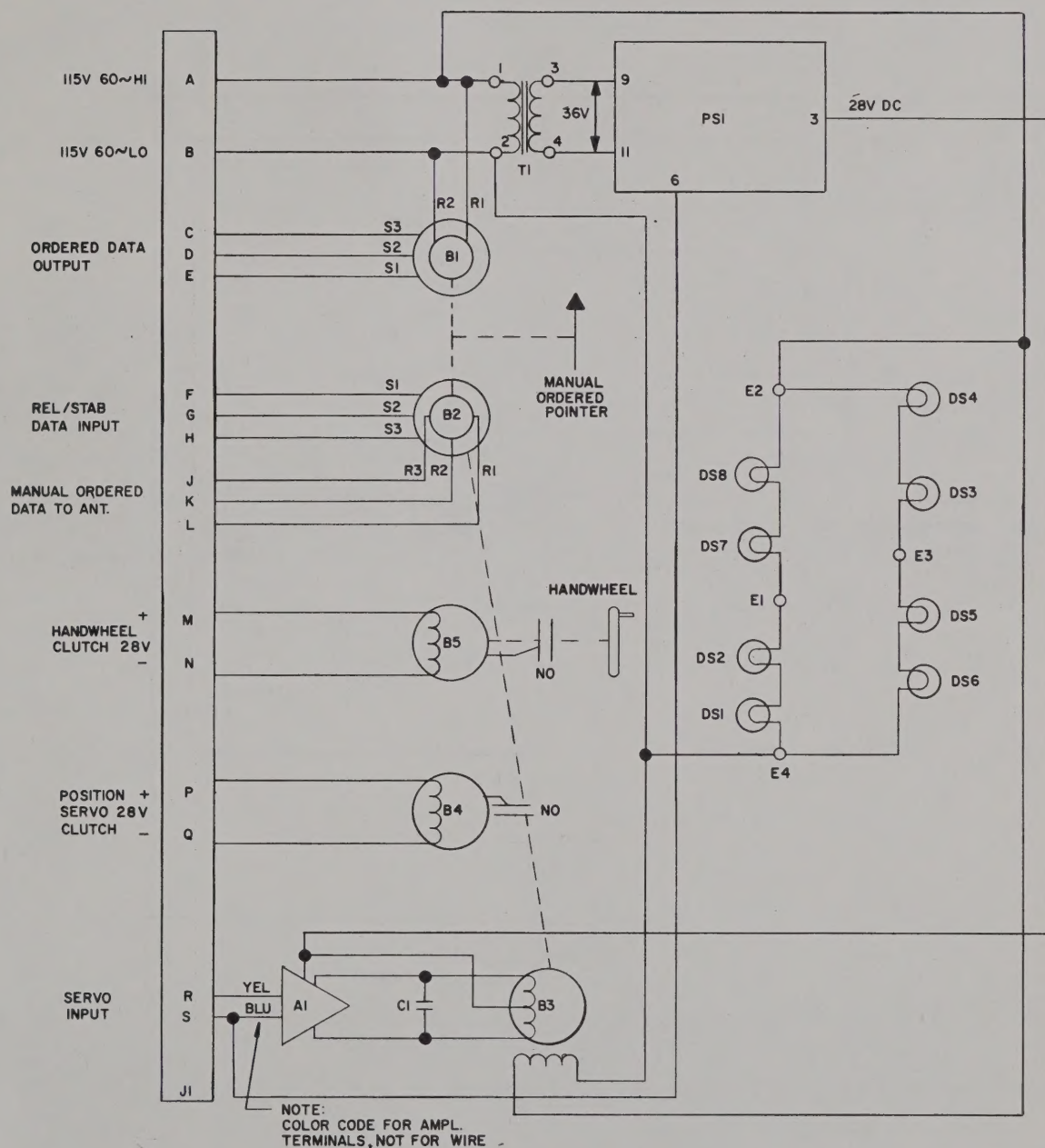


Figure 5-22. Schematic Diagram,  
Manual Ordered Bearing and Elevation  
Indicators - TM2

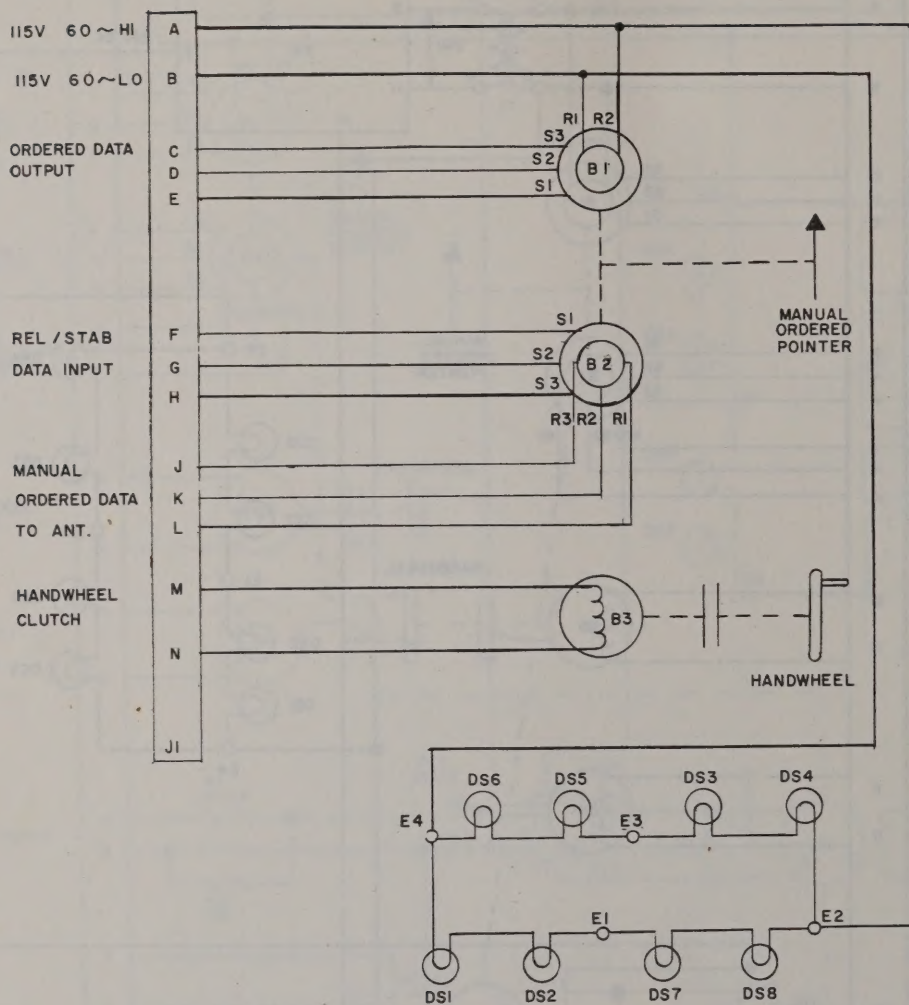


Figure 5-23. Schematic Diagram,  
Manual Ordered Bearing and Elevation  
Indicators - Command Control







